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(IJVLMS)

Interdisciplinary Journal of Virtual Learning in Medical Sciences (IJVLMS)

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JOURNAL INFORMATION

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- Introducing academics and experts in virtual education and publishing their findings
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Interdisciplinary Journal of Virtual Learning in Medical Sciences

Review Article

A Literature Review of the Effects of Virtual Community of Practice on Medical Education in China (2013-2023)

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ABSTRACT

Background: Given the rapid development of technologies, virtual community of practice (VCoP) has been employed across various fields, including education. In this context, it is essential to identify the utilization of virtual community of practice in medical education settings in China, particularly its effects on teaching methods and student learning. By understanding the effects of the virtual community of practice on college medical education, we can better evaluate the feasibility of introducing this technology to universities in economically disadvantaged areas. To this end, this study reviewed the literature to identify the potential benefits and challenges of implementing a virtual community of practice in the Chinese context and provide insights into how such an initiative can be effectively designed and implemented.

Methods: To identify the effects of the virtual community of practice on teaching and learning in Chinese medical education settings, we searched multiple databases such as PubMed, Google Scholar, and the University of Manchester Online Library. We focused on peer-reviewed English-language publications on virtual technology and medical education from 2013 to 2023.

Results: In Chinese medical education, traditional face-to-face teaching remains the primary instructional approach. This is understandable, considering that supplying a costly virtual community of practice to each student might be impractical, particularly for universities in economically disadvantaged areas. Nevertheless, the literature reviewed in this study suggests that if the virtual community of practice are employed appropriately, it can significantly enhance teaching by substantially reducing the budget required for constructing realistic medical scenarios.

Conclusion: To effectively promote the virtual community of practice for universities in economically disadvantaged areas, we advocated for establishing a dedicated medical education volunteer association as a form of the virtual community of practice to support medical education, which is enhanced by the virtual community of practice.

Keywords: Medical education, Virtual community of practice, Virtual learning technology, Higher education, China, learning equality, Review

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Introduction

Medical education contributes a lot to medical development. During the past 150 years, medical education trained medical practitioners with specific knowledge, skills, and attitudes (1). In the process of learning, they also have access to theories and technologies in other fields. As these trained physicians enter the medical field, they contribute to advances in other technological fields of medicine for further development (2-4). Meanwhile, because in the period of Covid-19, it is necessary to use transnational collaboration to improve medical health, and the internationalization of medical education has been expanded nowadays (5). Some scholars put forward new pathways in medical education (6), indicating the challenges medical education faces in adjusting its leadership and methods for using technology and digitalization (5).

Medical education has developed in China for hundreds of years since ancient times. However, medical education in China faces numerous challenges, including medical students' inability to apply their knowledge to real-world situations (7). Scholars have recommended multimedia as a potential solution to this issue (7), leading some Chinese universities to incorporate platforms such as Tencent Meetings and WeChat into their classrooms (8, 9). However, medical teachers have expressed concerns that the functions of Tencent Meetings and WeChat in their classrooms are too simple to satisfy their teaching needs (10). Therefore, this study explores the feasibility of a teaching model for medical college education based on a virtual community of practice.

In the medical or healthcare field, Community of Practice (CoP) has been widely used (2-4), which is defined as a group of individuals with similar interests, motivations, and concerns to meet regularly and share ideas (11). Accordingly, a Virtual Community of Practice (VCoP) is one kind of CoP with information and communication technologies, including social networking (12). In other words, VCoP is a group of individuals with the same interests and concerns who gather together to share ideas, knowledge, and experience through an online medium (13) and a kind of online learning community (14, 15). Due to the connection between VCoP and CoP, the structure of VCoP also consists of three participant groups, the same as CoP: the core, active, and peripheral groups (16).

Until now, VCoPs have been explored widely in the world. Many scholars from developed countries have investigated the feasibility of using VCoP to deal with some issues or improve treatment in a medical and medical-related field. Some have achieved some effective outcomes. In healthcare practice and performance, VCoPs are becoming effective knowledge-exchange tools (17). In sum, these studies focused on the method of using VCoPs in providing opportunities for participants to translate knowledge which has been seen to help bridge the gap between evidence and practice (18); this means that participants have access to increase their scope of knowledge through VCoPs, like the VCoP of general training practice in Australia, which aims to decrease the isolation in profession and structure (19). In other words, these studies indicate that VCoPs in medical and medical-related fields mainly function as learning communities. Most studies in this field have focused on the effect of specific VCoPs in specific fields. For instance, in 2016, the VCoP "clinic" - The Miners' Wellness TeleECHO - was built to educate various groups of professionals to care for miners in pneumoconiosis in the USA (9).

Only now, there is an obvious answer to whether using VCoP in medical education is suitable, so further research is required. This paper aims to make a theoretical contribution to the development of this field by conducting a holistic literature review. This study will focus on medical education in China to mitigate the cultural influence (20). There are three research questions: 1) What are the limitations in Chinese traditional medical education? 2) What are the

benefits and problems of VCoPs in Chinese medical education? and 3) How can VCoP be implemented in Chinese medical education?

Methods

This literature review followed Alexander's guidance through identification, screening, and eligibility (4).

The Identification Procedure

The research team started the identification procedure in PubMed, Google Scholar, and the University of Manchester Online Library. As to the comprehensiveness of research articles, the keyword research included several keywords: "virtual community of practice", "medical college", "medical education", and "model of instruction". In keyword searching, the research team found selecting suitable articles to explore medical education difficult. They then examined those articles that included VCoP and issues or improvements in medical and medical-related fields. Meanwhile, the research method took advantage of title research, which means that the title included various terms related to the virtual community of practice and medical education. Moreover, in this research, we used snowball methods to check the citations following each article to find those related to the topic in this study. It can provide definitions for some specific terms.

We completed the last search on the 1st of January 2024 and retrieved 53 records from the database search. To check the cited references of the eligible articles, we conducted a backward search and found another 17 records. By removing the duplicates of the overall 6 records, we kept the unique records for further screening (Figure 1).

The Screening Procedure

In the second step, the researchers screened the 64 articles by checking their titles and abstracts. The inclusion was: (1) VCoP must be the object which is explored in studies; (2) the content of studies must be in a medical and medical-related field instead of other fields; (3) the research methods in studies need to be controlled trial, and (4) it is necessary to use articles in the last five years. However, while reviewing previous studies, it was difficult to satisfy the third criterion because many articles prefer to use a mixed research method through control trials, surveys, focus groups, etc. After that, the third criterion was modified to include a controlled trial in research methods. After that, to ensure the comprehensiveness of the studies, we modified the last criteria to allow access to articles from recent ten years in addition to selected studies in the recent five years. Articles that provided definitions were excluded from this criterion. At this stage, there was a total of 45 suitable articles left for the next full-text screening.

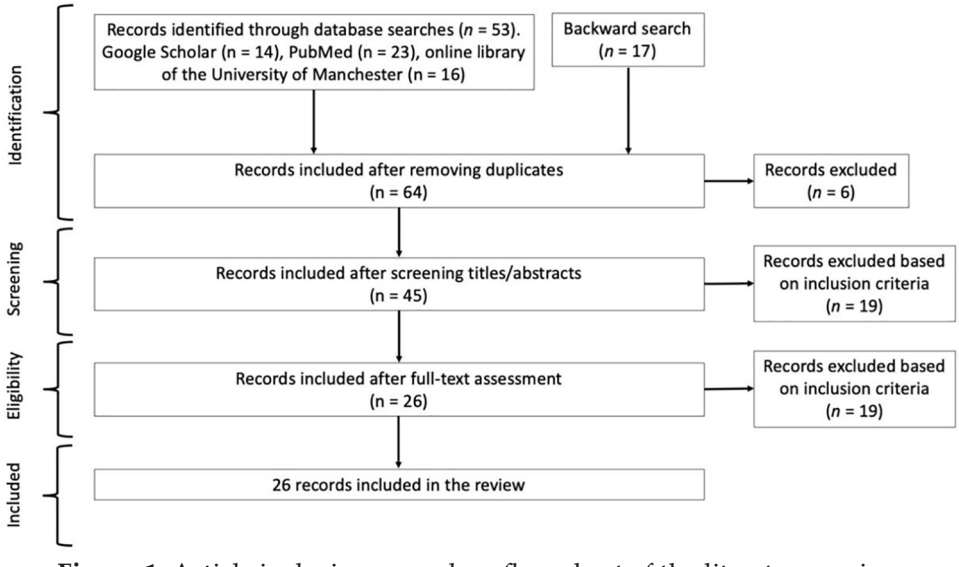

Figure 1: Article inclusion procedure flow chart of the literature review.

The Eligibility Procedure

It was the last stage of screening selected articles to determine which articles were suitable for the study based on the literature review. Researchers downloaded full-text PDF files of these 45 articles. In this process, the content of these articles was classified into several categories: the author, publication time, publication journal, journal rank, research purpose, research questions, and research target. Considering the criteria mentioned in the second stage, articles that did not meet the inclusion criteria were excluded from the dataset. At the same time, the findings and limitations of these articles were recorded as well. Finally, 26 articles were selected as the final review articles for the study.

Article Characteristics

Overall, researchers reviewed these academic articles in the past ten years, most of which were in the recent five years. Most of these articles explored one kind of VCoP function in a specific aspect of the medical and medical-related field. These studies were conducted in different countries and regions using several research methods. The sample size ranged from dozens to hundreds of participants. The participants were mainly medical practitioners and non-medical people, including workers, teachers, managers, etc. In most studies, the research methods used were mixed research strategies, including a controlled trial that classified research participants into two or more groups, asking them to use VCoP and collecting their feedback regularly.

Data Analysis

This study applied a literature-based method to analyze data from review articles. This introduced the reasoning that researchers discovered a confusing finding in examining inductive data and then attempted to explain the collected data to explore the research questions (21). This study collected data about the benefits of VCoPs and medical achievement and the limitations of using VCoPs in medical education. The process of coding information from the literature review included three steps: initial coding, focused coding, and theoretical coding (21). In the initial coding step, researchers considered the basic information of the selected articles, including the background, research purpose, research questions, research targets, methods, limitations, and findings. Before reading the selected articles, researchers had to create hypotheses based on the abstract to build a brief understanding of the structure. Then, it turned to the second step, focused coding. Researchers focused on more important factors from this basic information to the synthesis of large segments of data (21). In other words, researchers analyzed the articles based on the focused section, including research methods, limitations, and findings. According to this information, we concluded that the data collected from the reviewed articles were the findings from the perspective of theoretical coding.

Results

Chinese Traditional Medical Education

The analysis of the current literature indicated that China's medical education system has undergone numerous reforms over the past 70 years to achieve significant advancements. It is currently recognized as the world's most extensive medical education system (15). Face-to-face courses and hospital training are the primary methods of training medical college students. While the system was previously course-centred, recent years have seen that China has actively promoted competency-based medical education, focusing on student-centred learning to enhance the quality of training. However, even though the scale of Chinese medical education is the largest in the world, several factors exist which negatively influence the quality of Chinese medical education.

The first factor is the expansion of college enrollment, which causes a decline in the quality of medical education (22). In the academic year from 2018 to 2019, there were 286,219 undergraduate students, 81,128

postgraduates, and 14,044 MD students entering medical colleges (15). The medical education faculty and teaching resources still need to satisfy the expansion of the increasing number of students (15). In other words, the number of teachers and teaching resources is yet to keep up with the increase in the number of medical students, making it difficult for medical students to receive timely assistance from teachers in their coursework.

The second factor is geography. On the one hand, due to the unbalanced development of the regions in the economy, the level of medical education in underdeveloped regions is still slower than the expected standards of undergraduate medical education in China (15). It means that the teachers' sources and quality of textbooks in undeveloped regions are lower than those in developed regions. Meanwhile, due to the distance between different provinces, it is unavoidable for the communication among medical teachers to be influenced, further causing inconsistency in medical training, which harms building high-quality and reliable medical systems (15).

The third factor is its inflexibility. In the process of college medical education, medical schools have an inflexible teaching model (15). The primary pedagogic method in Chinese medical college education is teacher-controlled didactic lecturing, a passive teaching model. Students listen to teachers' imparting instead of thinking and exploring actively, which is viewed as an ineffective method (22). It is more evident in the classes held during the Covid-19 pandemic when teachers impart knowledge based on e-learning classes through Zoom, WeChat, and other online video apps. Most students preferred to turn off their microphones and cameras in classes, increasing teachers' difficulty in receiving feedback. Except for the teaching model, another issue displaying inflexibility is in the course contents. Biomedicine, medical technology, and clinical practice are often emphasized in medical college education (15), while other medical knowledge is neglected.

These factors mentioned above are social reasons. Nevertheless, given that Chinese medical education is a state-led system (23), the government plays an important role. The coordination mechanism between the education sector (supplier) and the health sector (demander) could be better (15), indicating that the cooperation between the education department and the medical department cannot satisfy the requirement of present China.

VCoPs in Medicine

Studies related to VCoPs in the past mainly focused on their function in specific medical issues. This study found some common points based on the literature review of the selected articles. VCoPs are viewed as learning communities with some factors; for example, there is an online space to share ideas and knowledge, participants interact with each other, and isolation is avoided (24). The participants of VCoPs are classified into the core, active, and peripheral groups (15). Due to the multiple characteristics of participants, their performance reflects the participation rate and the level of satisfaction for VCoP. Therefore, the benefits and problems of VCoPs are shown in the analysis.

Benefits of VCoPs: VCoP has high flexibility, which is one of the most important benefits. VCoP offers opportunities for participants to interact through forums and inactive video-conferencing sessions, making it easier to interact with different people (25). Its teaching and learning model allows the participants to attend classes at home and at their convenience rather than at a fixed time and place (26). Compared to medical college education in China based on face-to-face classes and e-learning through online video apps, it is evident that VCoP can provide more flexibility in time and place for people to learn. It is beneficial for the participants to learn from other experiences. At the same time, VCoPs occur at a central location in searching for information, which provides more accessible methods to identify materials and knowledge with a specific topic, decreasing users' time to search for resources (7) and then further providing more time for

users to learn and improve themselves.

Another benefit is that VCoP can provide comprehensive knowledge, referring to different fields which participants need in their learning or studies but have no access to. Studies in the past indicate that VCoP provides valuable materials for participants, defined as the latest knowledge and information (26). In Chinese medical education, isolation in medical knowledge appears widely due to limitations in the course content. It has been proven that VCoP allows interprofessional learning activities and collaboration among participants with different majorities (27). Meanwhile, VCoP provides the participants with tutorials and demonstration videos to manage independently (26). Barnett reported that the resources are most valued by doctors-in-training and tutors in VCoPs (28). Therefore, many people learn through VCoPs online learning and learning activities (29).

Problems in VCoPs: In addition to benefits, problems are unavoidable in VCoPs as well. The problems with which VCoPs are faced generally consist of the participants and technology. The first is related to participants. In a learning community, participants in VCoP can be classified into the core, active, and peripheral groups (30). These groups represent multiple roles necessary for vCoP success (31). Among multiple roles, the sense of belonging often plays an essential role in communities, ensuring that the community can operate by connecting the participants. It indicates that VCoPs need to consider the sense of belonging as well. Participants' trust in the specific platform determines their sense of belonging. However, after reviewing these selected articles in medical fields, it is hard to build a trusting relationship between VCoP users and the platforms. The main reason is that the online environment in VCoPs makes it hard to figure out other participnts' identities through facial expressions and body language (32). It is better to build trust through face-to-face contact (33).

Participants' identities have an impact on their attitudes to VCoP platform as well. These individuals who begin their careers are more likely to accept VCoP online forums than those who have worked for a long time (34).

The second is the requirement for technology. In the study of e-MPODERA VCoP, the researchers found that it is pretty hard for the participants to use VCoP in their workplaces because the computers and other equipment are outdated, making it impossible to access the VCoP platform (26). Or there is another situation in which the organization of the forums needs to be in order, causing it to be challenging to search for information (17). If it is easier for the participants to search for helpful information or open the website, they are more likely to feel disappointed (35), further influencing their attitudes toward VCoPs. On the other hand, it is difficult to find a suitable place and time to use VCoPs in a meaningful way (26). Even though VCoPs ensure that participants can use them at home, it could take much time for people to learn how to use them (26). It indicates that users must explore suitable methods to balance work and learning time through VCoPs.

Meanwhile, there is an exciting point in technology. Participants responded that it is inconvenient to remember their username and password in the platforms, limiting access to the VCoP platform (26). If participants need to remember this information, platforms need a satisfying method to help retrieve them. In general, VCoPs need a technological infrastructure supporting the online operation, which requires a more detailed design than traditional education, which takes advantage of teachers' imparting (26).

Discussion

The Usage Method of VCoPs in Chinese Medical College Education

A review of current literature shows that the strengths of VCoPs in class content are beneficial to address the problems in expanding medical school enrollment and the inflexibility of medical courses in Chinese traditional medical college education. With the development of Chinese society, the number of medical college students maintained an upward trend in the following years based on

the data from Wang's study (15). It is unlikely to solve such a problem by restricting medical school enrollment. Under such circumstances, finding another method to assist medical education is necessary. For the expansion, which causes the decline in education quality due to an imbalance between the number of medical students and that of medical teachers, it is beneficial to use VCoPs as a class aid which helps students reorganize acquired knowledge and supplement extra professional knowledge (36).

Then, it is helpful for VCoPs to decrease the imbalanced development in geography. Previous research has proven that VCoPs are a valuable tool for solving the problems caused by geographical boundaries (37). This study defines the VCoP as a virtual learning community based on online learning platforms that provide meaningful learning opportunities (38). In this aspect, VCoPs guarantee that the teaching and learning process can operate without considering the time and place. Besides geographical issues, knowledge isolation can be avoided by VCoPs as well. As mentioned in the section on benefits, VCoPs include various types of knowledge other than the course content, indicating that it is helpful for students to widen their scope of knowledge and think about knowledge from different perspectives of subjects.

Meanwhile, in traditional medical college education, teachers take advantage of the passive teaching style; teachers impart in classes, and students listen without interaction. After classes, there is no accessible method for college students to interact with their teachers in China, further hitting their motivation to learn actively. VCoPs provide forums after classes where students can share ideas and put forward questions, and teachers can answer questions and show their experience. It is effective in active learning for students.

The Barriers to Implementing VCoPs in Chinese Medical College Education

The analysis of the connection between the strengths of VCoPs and traditional medical education problems in China proves that using VCoPs to teach medical college education is feasible. However, it is unavoidable to have some barriers influence implementation. Only now, there is a specific platform provided for medical education. Even though VCoPs have been widely researched and explored abroad, it is still a start in China or a kind of advanced technology never used in medical education. At the same time, considering many medical students and that most college students live in schools, colleges cannot provide students with enough equipment to satisfy the technology requirement. Due to cultural and social background differences, VCoPs abroad mismatch Chinese specific requirements in medical college education, so creating a specific VCoP for medical education is necessary. However, it is still a long way to go.

Regarding the sense of belonging or the trust of VCoPs, facial expressions and body language influence the section of VCoP problems. VCoPs offer videos and live-streaming classes for students to learn, but there is no access for teachers to observe these factors of students. Therefore, it only depends on the students themselves. Meanwhile, according to Chinese students' performance in online courses during the Covid-19 pandemic, most students closed their cameras and microphones, further increasing the difficulty. Nevertheless, the most challenging issue is motivating students to participate in learning activities in VCoPs. According to the 90-9-1 rule for participation inequality in social media and online communities (2006), which collected the participants' responses to VCoPs' activities, it is surprising that only ten per cent of the participants were willing to actively in these learning activities. It is common for users to keep silent in using VCoPs, just searching for information and reading (39). Still, it is impossible to determine whether users actively participate (17).

Limitations and Suggestions

Unlike most previous research, which focuses on one specific aspect of VCoPs

based on their research objective, one of the strengths of this study is that it overviews research VCoPs in medical fields as comprehensively as possible. This systemic review provides a comprehensive, unbiased review of many relevant types of research in a single document (40). It is adequate to ensure accurate analysis of VCoP functions in medicine, which resulted from different research objectives. In other words, a systemic review is a method which minimizes the risk of error and bias in research (41). Based on the systemic review, this paper overviewed the situation of Chinese medical education and VCoPs in medicine to provide evidence for the feasibility of implementing VCoPs.

At the same time, we conducted a literature review to explore previous research through several steps: identification, screening, and eligibility, making searching for relevant articles easier. Reviewing systemically addresses a particular question or issue of importance to the field (41), and some articles, books, reports, and websites in systemic reviewing guides for authors to search (42).

There are also some limitations in this paper. On the one hand, even though this paper uses systemic review, it still has the limitation of other literature review articles; that is, the data analyzed come from previous research of other scholars, lacking relevance on the subject of this paper. Meanwhile, the accuracy of most previous research is limited by its sample size and fixed region. However, due to the different levels of participants in competencies, such as sophistication, commitment, expertise, experience, and collaboration (9, 28), it is hard to come to a general conclusion with a sample size ranging from 50 to 150 people. The fixed regions influence the accuracy of the research, just like the Miners' Wellness TeleECHO, which was limited to specific areas in the USA and did not focus on the whole of America to receive a general conclusion (9). In systemic review, there is no way to get new information not mentioned before.

On the other hand, a review article cannot avoid such a problem that has widely appeared in previous research: the trust problem. This problem is shown in two aspects. One is that the participants have their own biases. Because the research objective is VCoP, a kind of practice online, participants are more likely to be those who are willing to accept it (43), bringing inaccurate conclusions. This paper is limited by the inaccurate findings from these reviewed articles because of bias. Another aspect is technology. Some scholars pointed out that technology restricts the usage of VCoPs (26). In previous research, many scholars pointed out that the online environment makes it hard to build a trusting relationship (17, 26, 28). In the review, the authors can realize the limitation but need help finding solutions from previous studies.

The final limitation of this paper is that it only focused on articles published in Google Scholar, PubMed, and the online library of the University of Manchester databases, excluding the China National Knowledge Infrastructure (CNKI) database, so more detailed information about the Chinese situation is overlooked, which is possible to bring potential barriers in implementing VCoPs in Chinese medical education.

Conclusion

Although many studies have focused on using the virtual community of practice in medical education, particularly in America, only some studies have explored its feasibility in the Chinese medical education context. In this context, to fill a gap in the field of medical education research in China, this article utilizes a literature review to identify the potential benefits and challenges of implementing a virtual community of practice in the Chinese context and to provide insights into how such an initiative can be designed and implemented effectively. The scope of the present review spanned the 2013-2023 period. The existing literature indicates that if the virtual community of practice is applied correctly, it can positively teach students better. For example, virtual communities of practice can provide opportunities for meaningful student-faculty interaction

through forums and video conferencing and allow medical students to hone their skills operating on virtual patients. In this way, virtual communities of practice are likely to reduce the budget for building realistic scenarios significantly.

Of course, it is necessary to recognize the challenges and barriers to implementing a virtual community of practice, including technological barriers, privacy concerns, and the need for student training and support. For instance, whenever difficulties are encountered, students need to communicate with instructors or peers repeatedly, and sometimes comprehension of meaning requires facial expressions and body language. However, in virtual scenarios, medical students do not necessarily recognize the instructor's medical gestures, such as head nods, shoulder shrugs, and shakes. In this context, virtual devices have the potential to be rigid, narrow, and indifferent to the problem of students' inability to recognize medical gestures. Thus, we believe that replacing traditional face-to-face teaching may hinder rather than support medical students' learning.

For our third research question, given the high cost of implementing virtual community of practices and the expensive equipment, the idea of schools providing technical support for all students might be impractical, especially those in less economically developed regions. However, the high cost of virtual devices is only a problem with a solution. For example, we could call on Chinese medical education researchers to establish a particular Chinese medical education volunteer association (non-governmental organization), which might include virtual equipment suppliers, top medical education experts, and student teams as members. The organization can raise money through financial contributions and tax-efficient donations if registered as a charity. The proceeds can help pay for equipment (provided free access to students), teacher training fees, and scholarships.

Given the space limitation, this review only focused on peer-reviewed articles published from PubMed, Google Scholar, and the Online Library of the University of Manchester databases rather than including the China National Knowledge Infrastructure (CNKI) database. A potential consequence of not including articles from the CNKI database is that we might overlook unknown barriers to implementing virtual communities of practice in the Chinese medical education context. Despite its limitations, this study has undoubtedly increased our understanding of the advantages and disadvantages of implementing virtual communities of practice. Future research is recommended to use empirical data to design a formative or summative assessment tool to help faculty measure medical students' learning progress. The tool will include assessment criteria, level maps, and assessment items.

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Authors' Contribution

YS performed a Literature review, methodology, data analysis, writing-original draft, writing review, and editing; YZ performed validation, writing-original draft, writing-review, and editing; Li N also performed supervision, funding acquisition, writing-review and editing, project administration.

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Original Article

Unethical Use of Information Technology in Higher Educational Institutions: A Case Study of a Faith-Based University in Ghana

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ABSTRACT

Background: This study examined the unethical use of information technology among students in a Faith-based higher educational institution in Ghana. The choice of a Faith-based higher-level institution was based on the moral values and strict religious code of conduct inscribed in the culture of the university.

Methods: A cross-sectional primary data used for analysis was gathered from June to July 2021. The choice of a cross-sectional was to compare the perspectives of the gender, age groups, and economic levels among various students in the university. A structured questionnaire was provided online for students willing to participate in the study to complete and submit online. A sample size of 574 students answered the closed ended online questionnaire for data analysis. Gender and education level were used to assess the primary reasons for the unethical use of information technology by students. SPSS software version 21 was used for data analysis.

Results: Students who participated in the study were 239 males (42.5) and 324 females (57.5). Among some of the reasons for unethical behavior was easier access to information technology which enabled the students to engage in wrong activities (mean score 3.11, standard deviation 1.154). Students with financial support were less likely not to be involved in IT to perform well (mean score 3.00, standard deviation 1.169). The students working and studying at the same time had less time to study and resorted to unethical use of IT (mean score 3.26, standard deviation1.050).

Conclusion: This study recommends that universities should teach ethics of information technology as a stand-alone course, and that higher-level institutions should periodically present academic seminars on unethical use of information technology.

Keywords: Education, Distance, Technology, Unethical, Plagiarism, Higher educational institutions

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Introduction

Higher educational institutions exist to promote the growth and development of students to be accountable and socio-economically productive to the society (Dutton, Cheong & Park, 2004). Plagiarism is an unacceptable academic behavior and is significantly eschewed in all academic institutions (1). The quest to achieve academic success by using dubious means has become rife in several universities in sub-Saharan Africa (2). Unethical use of information technology is defined as the authorized use of online resources. In essence, it is the use of an author's work without appropriate citation. Plagiarism is defined as an unethical means of presenting another person's work as one's own (3).

There are several explanations for unethical use of online resources by students in higher educational institutions. The desire to achieve higher grades motivates the students to resort to purchasing online resources and answers to satisfy their assignment requirements. The pursuit of a degree for career opportunities has resulted in a wave of unethical behavior by millions of students seeking employment after school. Similarly, students who work either as self-employed and in corporate institutions pursue degree programs with the intention of meeting self-fulfilling life goals and for promotion.

Specifically, the tendency to accomplish academic work and succeed with little effort has gained much credence in higher educational institutions in sub-Saharan Africa (4). The ease of accessing online academic resources with limited restrictions and institutional sanctions on its use has created a culture of plagiarism. Students are constantly searching for easier ways to cheat by plagiarizing in their assignments and thesis work. However, in the pursuit of achieving their life-long academic dreams, they resort to the use of unethical resources to achieve their academic goals.

Unethical use of information technology has gained widespread attention because of the negative connotation often associated with it. Often the graduate who acquired a certificate using an unethical means have not acquired the requisite skills and knowledge suitable for any sustainable development of the society. The problems related to the students' plagiarism result in graduates who are unprepared to contribute productively to the 21st century world of work in sub-Saharan Africa. Several higher learning institutions in sub-Saharan African countries have developed stringent measures such as dismissal of students to significantly reduce the spate of unethical use of online resources. Aggressively controlling unethical use of online resources makes graduates who are equipped and resourceful for the world of work in the twenty-first century sub-Saharan Africa. The lack of critical institutional sanctions against software piracy, plagiarism, and cheating has become endemic and gradually degrading the quality of graduates from these institutions (5). Higher institutions of learning exist primarily to support the society in fostering innovations and continuously contribute to the growth of our 21st century world of work. As such, the primary role of higher education institutions is to provide learning materials and tools that will push learning to be more participatory and meaningful. Ultimately, higher education is responsible for the development of students' autonomy and the development of a resourceful society (6). Achieving a well-informed society requires a higher institution of learning equipped with the requisite information technology to provide meaningful services to education (7). The goal to make students productive and exceptional in their life pursuits unquestionably falls with a higher learning institution that offers the necessary learning resources in all forms. As such, the 21st century world of learning has been revolutionized by an industry which strives to significantly engage learners in digital devices.

This study indicates that; the issue of easy access to online resources has been abused and used flagrantly with little or no restrictions to monitoring students' assignments. Also,

it is revealed that limited contribution has been made by scholars in the area of ethical use of information technology by students in Faith-based institutions in sub-Saharan Africa. Much of the literature on unethical use of online resources have often focused on problems associated with social media use.

The general objective of this study is to find out the current status of unethical use of information technology by students in Faith-based higher learning institutions in sub-Saharan Africa. This study would seek to answer the following questions:

i) What is the general knowledge of students on information technology in Faith-based universities in Ghana?

ii) Why do students in Faith-based universities use information technology unethically?

iii) Is the unethical use of information technology in Faith-based universities in Ghana driven by gender or educational level?

Methods

Study Design

This is a descriptive cross-sectional study that aimed to assess the current state of unethical use of information technology by students in faith-based higher learning institutions in sub-Saharan Africa. The study was conducted between June and July of 2021."

Participants

Eligibility criteria for participants:

All undergraduate and graduate students who were affiliated with the Pentecost University in Ghana, were willing to participate in the study and provided informed consent, were enrolled in the study. Participants who did not complete more than 20% of the questionnaires were excluded from the study.

Sampling

The target population of the study comprised 2,730 students at Pentecost University in Ghana. To determine the sample size, we used Cochran's formula and Morgan's table.

Accordingly, the sample size was estimated to be around 330 individuals. However, considering the reduced accessibility to students during the pandemic and the possibility of attrition, we sent out questionnaires to 600 individuals, and ultimately received complete responses from 574 of them.

Data Collection Tools

A structured questionnaire were distributed online for students willing to participate in the study to complete and submit online. The data collection tool consisted of two parts. The first part focused on gathering demographic information such as age, gender, marital status, and educational level of the university students. The second part of the tool evaluated the extent to which students engage in unethical use of information technology, based on their perspective. This was done using closed-ended questions that allowed them to respond with either "yes (positive response)" or "no (negative response)." The reasons for a closed-ended questionnaire were meant to limit unnecessary responses that would not yield considerable benefit to the study's objectives. Steps to fully explain each questionnaire were taken to avoid ambiguity. The validity of the questionnaires was confirmed by five specialists in the fields of ethics and virtual learning. For reliability test, the Cronbach Alpha was 0.72 which indicates that the responses were reliable. Some of the students did not fully answer the questions and were excluded in the analysis for not answering specific questions. As a result, the total respondents utilized for such cases was 574.

Results

In all, 574 students completed the questionnaires and submitted them online, from both undergraduate and graduate studies. The demographic characteristics of the respondents are presented in Table 1.

Table 1 shows demographic characteristics of the respondents from the data; 42.5%

Table 1: Demographic Information of the Respondents

Variable	Demographics	Frequency	Percentage (%)
Sex	Male	239	42.5
	Female	324	57.5
	Total	563	100
Age in years	18-20	67	11.7
	21-23	119	20.8
	24-26	132	23.0
	27-29	127	22.1
	30-32	80	14.0
	≥33	48	8.4
	Total	573	100
Marital status	Single	356	62.3
	Married	135	23.6
	Separated	31	5.4
	Divorce	34	5.9
	Widow or Widower	16	2.8
	Total	572	100
Educational level	Diploma	99	17.4
	Level 100 (Year One)	108	19.0
	Level 200 (Year Two)	103	18.1
	Level 300 (Year Three)	74	13.0
	Level 400 (Year Four)	102	17.9
	Post Graduate	83	14.6
	Total	569	100

were male, and the remaining 57.5% were female. In the age group category, 32.5% were between the ages of 18-23, 45.2% between the ages of 24-29, and the rest were up to or above 30 years. Also, 62.2% were single, but 23.6% were married; 5.4% of them were separated, 5.9% were divorced, and 2.8% had lost their spouses. The highest respondents were Level 100 students, 19.0% and the least were, level 300 students, 13.0 %.

Table 2 is the result of test for research "Question One". We found the students' understanding of unethical information technology by asking the following questions. These three questions provided specific answers to students' perspectives on unethical use of information technology.

Analysis of their responses showed that 78.6% selected the positive answers, and 21.4% provided negative answers. This suggests that most of the students are aware of the illegal activities undertaken regarding information technology at all times. Another question was "Do you agree that ethical use of information technology shows a person's morality?" It emerged that 74.2% answered "yes" and 25.8%" no". The results are shown in Table 2 above.

The study sought to find out through the students' perspectives why people get involved in unethical use of information technology. Specific questions were asked. The questions started with "Do you think the following factors can be an impediment to adherence to the information technology ethics? If you agree, tick "Yes" and if you disagree, tick "No".

The first one was lack of money; 73.4% agreed to the fact that lack of money can be an impediment to adherence to the correct use of information technology. On the contrary, 26.6% answered "No". As to peer pressure, 69.9% said "Yes" and 30.1% said "No". Peer pressure cannot be an impediment in the wrong usage of information technology. On ineffective punitive measures, 34.5% answered yes, but 65.5% said no. This suggests that learners involved in unethical

Table 2: Students' Knowledge on Unethical Information Technology

Question	Response	N	(%)
Have you heard about plagiarism before	Yes	451	78.6
	No	123	21.4
	Total	574	100.0
Ethical use of information technology shows a person's morality	Yes	426	74.2
	No	148	25.8
	Total	574	100
Do you think the following factors can be an impediment to the adherence of the information technology ethics?			
Lack of money	Yes	309	73.4
	No	112	26.6
	Total	421	100
Peer pressure	Yes	295	69.9
	No	127	30.1
	Total	422	100
Ineffective punitive measures	Yes	135	34.5
	No	265	65.5
	Total	400	100
Poor economic situation of the country	Yes	210	51.3%
	No	199	48.7%
	Total	409	100

Table 3: Internet Usage and its Reasons

Components	N	(%)
Internet User		
Yes	544	96.3
No	21	3.7
Total	565	100
Reasons for Usage		
All Reasons	91	15.9
Education, Information & Socialization	313	54.5
Education, Information &Cheating	13	2.3
Education &Cheating	6	1.0
Education &Social	8	1.4
Education & Information	28	4.9
Social & Information	10	1.7
Social & Cheating	6	1.0
Cheating only	13	2.3
Education only	29	5.1
Socialization	13	2.3
Information	29	5.1
Information and Cheating	9	1.6
Information, Socialization and Cheating	2	0.3
Total	570	99.3
No Response	4	0.7
Total	574	100.0

use of information technology are aware of the consequences. Over 51% said that poor economic situation of the country can lead to unethical use of information technology. All respondents agreed that students use unethical information from the Internet; interestingly, 3.7% said they did not use the Internet since they did not own a laptop (Table 3), although they used their mobile phones to access the Internet.

Table 3 also answers "Research Question One"; it highlights Internet usage and its reasons. As indicated, students use Internet resources based on various reasons. From the responses, 24.6% selected at least cheating and any other reasons (that is close to a quarter), and those not involved in cheating were 75.4%. This is a clear indication that some of the students themselves accept that they do use information technology unethically. The next table illustrates the reasons the students stated for involving in unethical use of the information technology.

Cheating in this paper refers to plagiarism, software pirating, and all the unethical use of information technology. The study also sought to highlight the key reasons behind violations of information technology use. Respondents were asked to provide information on motivations behind violations of information technology; these were statements on a Likert scale scored 1=Strongly disagree (SD); 2=Disagree (D); 3=Neutral (N); 4=Agree (A); 5=Strongly agree (SA). The responses from the nine statements are shown in the Table 4a below. It answers "Research Question Two" which are the reasons students often gave when they were involved in unethical information technology use.

Table 4 displays the students' opinions regarding the reasons for violation of information technology among students, and Figure 1 illustrates the average opinions.

The first statement was "Easy access to information technology enables students to use it for different wrong activities"; 27.8% either agreed or strongly disagreed, 47.1% agreed or strongly agreed, and 25.1% were neutral (M=3.11, SD=1.15). The next statement was "Students with financial support are likely not to be involved in unethical information technology to perform well". The analysis showed that 35.3% either strongly disagreed or disagreed, and 43.6% strongly agreed or agreed. The corresponding mean and standard deviation were 3.00 and 1.17. Again, the study sought to find out whether many courses offered by students made it easier to plagiarize. It was found that 19% disagreed or strongly disagreed, and 55% agreed or strongly agreed, but 26.5% were neutral. The mean was 3.35 and standard deviation 0.999. With the rest of the statements, more than 50% either agreed or

Table 4: Reasons for Violation of Information Technology among Students

Statements	SD	D	N	A	SA	Total
S1. Easy access to information technology enables students to use it for different wrong activities.	74 (13.2)	82 (14.6)	141 (25.1)	226 (40.3)	38 (6.8)	561 (100)
S2. Students with financial support are likely not to be involved in unethical IT to perform well.	79 (13.8)	123 (21.5)	121 (21.1)	219 (38.2)	31 (5.4)	573 (100)
S3. Many courses offered by students can make it easier to plagiarize.	37 (6.45)	72 (12.6)	152 (26.5)	275 (48.0)	37 (6.45)	573 (100)
S4. Student working and studying at the same time do not have time to study and get involve in unethical use of IT.	42 (7.3)	92 (16.1)	138 (24.1)	262 (45.7)	39 (6.8)	573 (100)
S5. Lack of instructions from lecturers for students' use of IT makes it easier for students to cheat.	46 (8.0)	98 (17.1)	130 (22.7)	261 (45.5)	38 (6.7)	573 (100)
S6. Ineffective country laws on ethical use of information technology can lead to violation of IT ethics.	24 (4.2)	60 (10.4)	118 (20.6)	312 (54.5)	59 (10.3)	573 (100)
S7. Program of study, gender and computer experience have effect on students' judgment regarding IT ethics.	41 (7.1)	72 (12.6)	135 (23.5)	296 (51.6)	30 (5.2)	574 (100)
S8. Lack of understanding of ethical use of new technology may lead to irresponsible use.	38 (6.7)	42 (7.3)	128 (22.3)	3/803 (52.9)	62 (10.8)	573 (100)
S9. IT resources provide capabilities and opportunities for unethical acts and positively influence students' intention for the act.	36 (6.3)	70 (12.2)	148 (25.9)	286 (50.0)	32 (5.6)	572 (100)

*Strongly disagree (SD); Disagree (D); Neutral (N); Agree (A); Strongly agree (SA)

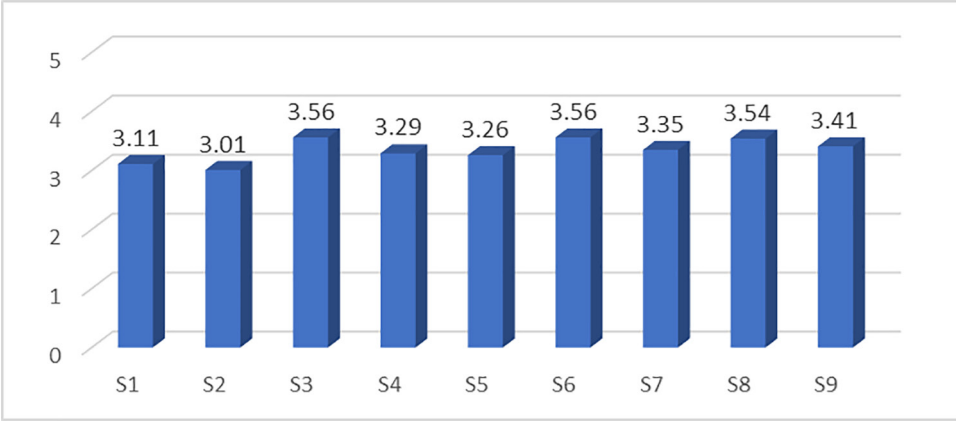

Figure 1: The average of the students' opinions regarding the reasons for violation of information technology

Table 5: Cross-tabulation of Sex and Reasons for Violation of IT among Students

Response		SD		D		N		A		SA		Total	
S1	Female	28	(8.7)	49	(15.2)	71	(22.0)	149	(46.1)	26	(8.0)	323	(100)
	Male	44	(18.4)	42	(17.6)	68	(28.5)	73	(30.5)	12	(5.0)	239	(100)
S2	Female	37	(11.4)	58	(17.9)	60	(18.5)	151	(46.6)	18	(5.6)	324	(100)
	Male	40	(16.7)	64	(26.8)	57	(23.9)	65	(27.2)	13	(5.4)	239	(100)
S3	Female	16	(4.9)	30	(9.3)	79	(24.4)	178	(54.9)	21	(6.5)	324	(100)
	Male	21	(8.8)	40	(16.7)	71	(29.7)	93	(39.8)	14	(15.9)	239	(100)
S4	Female	18	(5.6)	47	(14.5)	71	(21.9)	172	(53.1)	16	(4.9)	324	(100)
	Male	23	(9.6)	42	(17.6)	66	(27.6)	86	(36.0)	22	(9.2)	239	(100)
S5	Female	20	(6.2)	51	(15.7)	67	(20.7)	165	(50.9)	21	(6.5)	324	(100)
	Male	25	(10.5)	46	(19.2)	61	(25.5)	91	(38.1)	16	(6.7)	239	(100)
S6	Female	12	(3.8)	30	(9.2)	69	(21.3)	186	(57.4)	27	(8.3)	324	(100)
	Male	12	(5.0)	28	(11.7)	46	(19.3)	122	(51.0)	31	(13.0)	239	(100)
S7	Female	17	(5.2)	41	(12.7)	71	(21.9)	184	(56.8)	11	(3.4)	324	(100)
	Male	24	(10.0)	29	(12.1)	61	(25.5)	107	(44.8)	18	(7.6)	239	(100)
S8	Female	18	(5.6)	20	(6.2)	62	(19.1)	197	(60.8)	27	(8.3)	324	(100)
	Male	20	(8.4)	22	(9.2)	60	(25.2)	102	(42.9)	34	(14.3)	238	(100)
S9	Female	12	(3.8)	35	(10.9)	80	(24.9)	177	(55.1)	17	(5.3)	321	(100)
	Male	22	(9.2)	35	(14.4)	65	(27.2)	106	(44.4)	11	(4.6)	239	(100)

Strongly disagree (SD); Disagree (D); Neutral (N); Agree (A); Strongly agree (SA)

strongly agreed, and with some less than 20% disagreed or strongly disagreed. Even in the case of ineffective laws in the country, 60% agreed or strongly agreed with the statement, with a mean of 3.56 and standard deviation of 0.958. All these show that students are aware of unethical use of information technology.

The study used cross-tabulation distribution of responses by the students' gender and the educational level of the student against the reasons given by each student in the table showing the unethical conduct. Thus, Tables 5 and 6 are the result of the test for "Research Question Three". The objective of this section is to find out the reasons by gender and education.

As Table 5 shows, there were mixed responses from both genders. For example, as to "Easy access to information technology enables students to use it for different wrong activities," whereas 23.9% of the females disagreed or strongly disagreed, 36.0% of the males responded similarly. On the contrary, more than half (54.1%) of the females agreed or strongly agreed to the statement, while only 35.5% of the males answered positively.

Table 6: Education level and Reasons for Violation of Information Technology among Students

Cheap access to information makes it easy to cheat (1)						
Response	**Dip**	**L100**	**L200**	**L300**	**L400**	**Grad**
S1. Cheap access to information makes it easy to cheat						
S.D	12 (12.1)	18 (16.8)	13 (12.7)	12 (16.2)	10 (9.8)	9 (10.8)
D	13 (13.2)	17 (15.9)	19 (18.6)	10 (13.5)	18 (17.6)	14 (16.9)
N	20 (20.2)	20 (18.7)	28 (27.5)	23 (31.1)	27 (26.5)	23 (27.7)
A	52 (50.5)	42 (39.3)	31 (30.4)	23 (31.1)	43 (42.2)	32 (35.6)
SA	2 (2.0)	10 (9.3)	11 (10.8)	6 (8.1)	4 (3.9)	5 (6.0)
S2. Students with Financial Support less likely to cheat						
S.D	10 (10.1)	15 (13.9)	15 (14.5)	12 (16.2)	14 (13.7)	12 (14.5)
D	13 (13.2)	23 (21.3)	28 (27.2)	12 (16.2)	23 (22.5)	22 (26.5)
N	18 (18.2)	16 (14.8)	25 (24.3)	23 (31.1)	23 (22.5)	15 (18.1)
A	55 (55.5)	45 (41.7)	30 (29.1)	24 (32.4)	37 (36.3)	28 (33.7)
SA	3 (3.0)	9 (8.3)	5 (4.9)	3 (4.1)	5 (5.0)	6 (7.2)
S3. Many courses offered by students leads to plagiarism						
S.D	9 (9.1)	3 (2.8)	5 (4.9)	8 (10.8)	6 (5.9)	6 (7.2)
D	11 (11.1)	16 (14.8)	19 (18.4)	4 (5.4)	14 (13.7)	8 (9.6)
N	18 (18.2)	34 (31.5)	24 (23.3)	30 (40.5)	24 (23.5)	20 (24.1)
A	56 (56.6)	50 (46.3)	48 (46.6)	27 (36.5)	51 (50.0)	41 (49.4)
SA	5 (5.0)	5 (4.6)	7 (6.8)	5 (6.8)	7 (6.9)	8 (9.7)
S4. Working and Studying at the same time						
S.D	6 (6.1)	6 (5.6)	8 (7.8)	7 (9.5)	8 (7.8)	7 (8.4)
D	7 (7.1)	25 (23.1)	21 (20.4)	11 (14.9)	13 (12.8)	13 (15.7)
N	22 (22.2)	21 (19.4)	22 (21.4)	22 (29.7)	29 (28.4)	22 (26.5)
A	61 (61.6)	49 (45.4)	43 (41.7)	28 (37.8)	43 (42.2)	36 (43.4)
SA	3 (3.0)	7 (6.5)	9 (8.7)	6 (8.1)	9 (8.8)	5 (6.0)
S5. Lack of role from lecturers for students lead to cheating						
S.D	8 (8.1)	12 (11.1)	7 (6.8)	9 (12.1)	6 (5.9)	4 (4.8)
D	4 (4.1)	18 (16.7)	17 (16.5)	15 (20.3)	27 (26.5)	15 (18.1)
N	23 (23.2)	20 (18.5)	24 (23.3)	21 (28.4)	23 (22.5)	19 (22.9)
A	61 (61.6)	52 (48.1)	46 (44.7)	23 (31.1)	40 (39.2)	37 (44.6)
SA	3 (3.0)	6 (5.6)	9 (8.7)	6 (8.1)	6 (5.9)	8 (9.6)
S6. Ineffective country law on ethics						
S.D	2 (2.0)	3 (2.8)	4 (3.9)	8 (10.8)	3 (2.9)	4 (4.8)
D	10 (10.1)	13 (12.0)	8 (7.8)	6 (8.1)	15 (14.7)	8 (9.6)
N	22 (22.2)	17 (15.7)	19 (18.4)	22 (29.7)	21 (20.6)	16 (19.3)
A	60 (60.6)	69 (63.9)	55 (53.4)	29 (39.2)	50 (49.0)	47 (56.6)
SA	5 (5.1)	6 (5.6)	17 (16.5)	9 (12.2)	13 (12.8)	8 (9.7)
S7. Programme of Study and gender						
S.D	6 (6.1)	5 (4.6)	7 (6.8)	9 (12.2)	6 (5.9)	8 (9.6)
D	7 (7.1)	19 (17.6)	12 (11.7)	11 (14.9)	9 (8.9)	12 (14.5)
N	26 (26.2)	24 (22.2)	20 (19.4)	18 (24.3)	29 (28.7)	18 (21.7)
A	56 (56.6)	52 (48.2)	57 (55.3)	32 (43.2)	53 (52.5)	43 (51.8)
SA	4 (4.0)	8 (7.4)	7 (6.8)	4 (5.4)	4 (4.0)	2 (2.4)
S8. Lack of understanding of ethical use						
S.D	4 (4.0)	8 (7.4)	6 (5.8)	6 (8.2)	9 (8.8)	5 (6.0)
D	7 (7.1)	9 (8.3)	5 (4.9)	7 (9.6)	5 (4.9)	9 (10.8)
N	26 (26.2)	27 (25.0)	20 (19.4)	17 (23.3)	21 (20.6)	17 (20.5)
A	58 (58.7)	55 (51.0)	54 (52.4)	32 (43.8)	58 (54.9)	48 (54.2)
SA	4 (4.0)	9 (8.3)	18 (17.5)	11 (15.1)	11 (10.8)	7 (8.4)

Cheap access to information makes it easy to cheat (1)						
Response	**Dip**	**L100**	**L200**	**L300**	**L400**	**Grad**
S9. IT Resources provide opportunities to cheat						
S.D	5 (5.1)	10 (9.3)	5 (4.8)	6 (8.2)	5 (4.9)	5 (6.0)
D	11 (11.1)	9 (8.3)	17 (16.5)	9 (12.3)	13 (12.8)	11 (13.3)
N	16 (16.2)	24 (22.2)	30 (29.1)	31 (42.5)	26 (25.5)	21 (25.3)
A	62 (62.6	61 (56.5)	40 (38.8)	25 (34.3)	54 (52.9)	41 (49.4)
SA	4 (4.0)	4 (3.7)	10 (9.8)	2 (2.7)	4 (3.9)	5 (6.0)
S.D	99 (100)	108 (100)	103 (100)	73 (100)	102 (100)	83 (100)

Strongly disagree (SD); Disagree (D); Neutral (N); Agree (A); Strongly agree (SA)

The second statement was "Students with financial support are unlikely to find themselves involved in unethical information technology use to perform well." They adhered to the same pattern discussed earlier. However, the third statement which states that "many courses offered by students can make it easier to plagiarize" showed slightly different responses. There were over 60% of the females that agreed or strongly agreed, and over 55% of males responded similarly. Responses from the fourth statement "student working and studying at the same time do not have time to study and engage in unethical use of information technology" and the fifth question which indicated that "lack of clarification from lectures for students" use of information technology makes it easier for students to cheat" were not different from the statements one and two. Responses from the sixth, seventh and eighth statements followed that of the third statement, but the ninth statement answers were similar to the first statement. The following section is the responses based on the current level of study and the reasons for the unethical use of information technology by the students (Table 5).

As to statements 1 in Table 6, it is noticed that over 50% of students pursuing diploma and at Level 100 (first year) strongly agreed that easier access to information technology enabled them to engage in unethical activities; the rest were less than 50% with the least being 30.4% as responses from the Level 200 (second year) students. In statements 2, the pattern of responses was not different from the first statement, "Students with financial support are less likely to be involved in unethical information technology use to perform well". Thus, the students know very well that they are involved in unethical use of information technology in their field of studies. The result here suggests that students at the early years of studies appear to agree with the statements.

The analysis of the third and fourth statements were done based on their education level. This pattern was not significantly different from the previous statements. For all the educational levels, over 50% either agreed or strongly agreed to the statements, and over 60% of the diploma students favored the fourth statement. The Level 300 (third year) students tended to be more indifferent in their responses though all the other year's cohorts' responses in the neutral section appeared not to differ too much.

The statements 5 and 6 were "Lack of roles from lecturers for student's use of information technology makes it easier for students to cheat" and "ineffective country laws on ethical use of information technology can lead to violation of IT ethics". The responses for ineffective country laws were highly in favor of agreed or strongly agreed. This is another indication that students are well informed of the wrong use of information technology, albeit they continue to do it. Responses from statements 7, 8 and 9 all follow the same pattern. These are displayed in Table 6

Discussion

Results of the study corroborate the findings by (8), indicating that access to the Internet and availability of online databases

contribute to flouting of ethics in information technology. Further, ineffective country laws on ethical use of information technology were found to be one of the causes of students' cheating and copying verbatim. This study found out that students with extensive financial support from parents or guardians were less likely to violate information ethics. This is not in the same line with the findings by scholars such as (9). The studies have observed that the desire to obtain high grades to please their parents or guardians is the strongest motivation for violating ethics of information. A study researchers (10) hold the opinion that the 21st century world of higher institution of learning is made of students who are so much attached to technology, with little professional experience and are prone to violating information ethics practically. On one hand, this study found out that students who participated in this study held the perspective that easy access to the Internet was one of the reasons in using information technology unethically. On the other hand, (11) assert that software is expensive for students in sub-Saharan African, as compared to their counterparts in the Western world.

The finding that students are aware of plagiarism conforms to (12) who asserts that Egyptian students are quite familiar with plagiarism. This can be said to be academic dishonesty as declared by (11). The factors that could inhibit adherence to computer ethics as expressed by most of the respondents were attributed to the poor economic situation of the country, peer pressure, and lack of financial resources. The findings of this study conform with other socio-economic circumstances in Ghana, where students and employees in both private and public sector organizations are engaged in other social vices with the excuse of economic hardships. This is in line with (13) who stated that unethical behaviors associated with the use of information technology might be caused by economic, social, moral, or personal reasons. Further, (14) also found some of the reasons identified for increasing software piracy (illegal downloading of qualitative and quantitative research software) to include lack of sustainable monthly income. Students agreed to ineffective country laws which enable easy means to indulge in unethical use of information technology. Furthermore, (15) also substantiated the findings of their paper by indicating that adult students, particularly those working, have a strong drive to use unethical approach to their academic work. The authors suggest that frequent training sessions on academic integrity should be held for these students to ensure conformance with academic integrity. Similarly, the findings of this paper are consistent with those of the study by (16) who asserted that attitude, subjective norm and perceived control were the key factors that influenced unethical behavior of students in the use of IT. On the contrary, environmental conditions can be a sufficient reason for some of the differences in the findings. Particularly, access to online resources in Ghana is a bit unreliable and erratic because of the poor digital infrastructure.

Limitations and Suggestions

One primary limitation related to this study is based on the fact the data collected is only from one Faith-based university. This does not provide a comprehensive review of unethical use of information technology in sub-Saharan Africa. This study thus assert that the identity of Faith-based institutions should be upheld in terms of moral code of conduct and integrity. The identity of Faith-based universities should be guarded at any cost to ensure that students are equipped with the highest level of integrity, honesty, and truthfulness. The fact that Faith-based universities represent the moral fabric of the society should be sacred and enshrined in the moral structure of the student's handbook. Compromises should not be tolerated, and stringent measures should always be provided to safeguard academic integrity and its moral sustainability in any way.

Conclusion

This study was conducted to examine unethical use of information technology in

a Faith-based higher institution of learning. It was concluded that students found easy access to online resources for their academic work because of less stringent measures put in place by these institutions to regulate their use. Students also perceived access to online resources as the easiest means to attaining their academic journey due to the lack of monitoring by their tutors and supervisors. Further, the availability of online academic resource personnel who are engaged in writing the academic papers of students for monetary rewards has ruined the credibility of higher institutions of learning in sub-Saharan Africa. Importantly, Faith-based institutions should enact moral standards and ethical structures to moderate the students' engagement of unethical academic practices. Much effort should also be geared towards regular institutional monitoring and seminars to stem the tide of unethical use of information technology in higher learning institutions in sub-Sahara African countries.

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Authors' Contribution

PO wrote the research questions, analyzed and interpreted the results, undertook the research interviews with participants. RA prepared the first draft of the manuscript and helped his colleague analyze the findings. All researchers approved the final paper.

Conflict of Interest: None declared.

Ethical Consideration

The study commenced following approval by the local ethics committee and coordination with the vice president of research at the universities. The informed consent of the participants and strict observance of the human rights for the study participants have been duly respected based on the underlying principles of this research study. Before starting the study, the researcher explained the study objectives to the participants over a phone call and emailed them an informed consent form, which they were required to sign before participating in the study. To protect the confidentiality and privacy of the participants, we included no identifying information such as names in the surveys. This paper is a further study of a previous work on unethical use of information technology in public universities in sub-Saharan Africa.

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Interdisciplinary Journal of Virtual Learning in Medical Sciences

Original Article

The Relation of E-learning with the Perception of a Constructive Environment: The Mediating Role of Learner and Teacher Abilities

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ABSTRACT

Background: With the beginning of the 21st century, the necessity of transformation in education has become clear to everyone, and technology is the starting point of this transformation. The current research was conducted with the aim of investigating the relationship of e-learning with the perception of a constructive environment with the mediating role of learner and teacher abilities in high schools of Kerman city.

Methods: This correlational study was performed using structural equation model between from 2021 to July 2020. The samples were 150 high school principals, experts, teachers, and students of Kerman city high schools in 2021 who were selected via convenience sampling. of these, 30 were experts and school teachers, and 120 subjects were high school students. The research tool was a 45-questions researcher-made questionnaire of the factors related to the enrichment of online education and a questionnaire of the perception of the constructivist learning environment based on the facts and Karsheki (2014). The face validity of the researcher-made questionnaire was confirmed based on the experts' opinions, and the exploratory factor analysis confirmed the 4-factor structure of the questionnaire. The reliability of the questionnaire was confirmed based on the calculation of Cronbach's alpha coefficient. Data analysis was done using structural equation modeling method in AMOS software.

Results: Using structural equation modeling, the relationship between family structure, educational system, learner ability, teacher ability, and perception of constructivist learning environment was investigated. The values of path coefficients and indirect effects showed that family structure with path coefficient (0.45) and educational system with path coefficient (0.18) indirectly influenced the perception of constructivist environment through the ability of the students. Also, the educational system with path coefficient (0.26) indirectly influenced the perception of constructivist environment through the teacher's ability. The mean and standard deviation of the sample group's scores in the variables of learner ability, teacher ability, and perception of constructivist learning environment were 27.39 and 4.10, 21.37 and 4.08, and 79.05 and 7.79, respectively. These variables included different dimensions that had a score range between 2 to 10, 2 to 4, and 10 to 50.

Conclusion: Designing and managing various processes of the online learning system, keeping in mind the empowerment of various dimensions related to this system, namely knowledge, learner, teacher, and family.

Keywords: Distance, Family structure, Educational system, Perception, Constructive, Environment, Aptitude

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Introduction

E-learning is the act of learning how to use electronic tools and procedures. Web-based learning, computer-based learning, virtual classrooms, and online collaboration are all examples of e-learning methods and applications. Capabilities of the Internet, intranet, extranet, satellite TV, and CD-ROM with multimedia (1). are all used to provide content at the beginning of the 21st century; the necessity of evolution and change in education has become clear to everyone, and technology is the starting point of this evolution because it has affected our daily life. By entering the era of information and communication and due to the investing problems in education as well as air pollution caused by the transportation of teachers and students and the high cost of education, conventional education no longer meets the current needs of the new generation (2).

Another reason for the necessity and importance of virtual education is to speed up learning according to desired process. Certainly not everyone's learning speed is the same. In traditional methods, students must adapt to the speed of the class. Some students need more repetition to memorize information; some need to increase the speed of learning; otherwise, they spend boring hours in class. One of the advantages of online education is that we can learn at our own pace, which makes the learning process much more enjoyable. Therefore, another reason for the importance of virtual training is the possibility of repeating the videos multiple times, which personalizes the learning speed for students (3).

One of the most popular reasons for the importance of online education is that we can attend the class online or receive the class file completely in case of absence. If one participates in e-learning classes online, he/she can stay in the course of teaching, and if one has any doubts or questions, he/she can simply ask them. E-learning is a very suitable option for working people and people who have a lot of work. Daily work may not give enough time to sit in face-to-face classes, and in case of persistent absences, one will have to cancel the lesson. In this case, one may not understand the subject even by reading his/her classmates' pamphlets. However, in e-learning, we don't have to attend all online classes (4).

One of the problems that exists in all societies and countries is the imbalance between facilities in different cities and regions. Undoubtedly, the quality of education and the facilities of the same subject in an educational institution in a small city are much lower than a higher institution in a big city like Tehran. However, in electronic education, this problem has been completely solved. Whether it is in one of the border and remote villages or in the center of Tehran, an electronic education class with the same quality will be held. This issue can undoubtedly be considered as one of the reasons for the necessity and importance of electronic education, which creates equal and suitable conditions for all people (5). One of the problems of face-to-face training and classrooms is the limited educational facilities and the lack of use of visual, digital, and online aspects in education. Imagine that in a face-to-face class, the teacher talks about the growth and development of a plant. In e-learning classes, one can watch the steps in the form of videos, animations, simulators or any other visual aspects along with the instructor's explanations and learn the concept completely and forever. Flexibility is another reason for the importance of e-learning, which increases the quality of education to a great extent (6).

In the traditional education method, place and time are very important for participating in an educational course, but these barriers have lost their meaning in online education. Many times, it might have happened to those who have been looking for a training course for a long time and after a while they find out that the course is held in another city (7). The cost of commuting, the difficulty of the road, taking leave from work and other reasons make stop going to the training course despite the inner desire. However, another

advantage and reason for the importance and necessity of e-learning is that one can participate in courses abroad without any time limit. Therefore, another advantage of virtual education and its importance is that this method can provide the students with a new window of learning opportunities because many international courses will help get more ideal job opportunities in the future. (8). E-learning is a very suitable educational method for people who have physical disabilities, and it is difficult for them to go to face-to-face courses. These people can easily register in all online courses and participate in online classes at their own home with no need to go to another place. Another positive feature of e-learning is that the learning environment is removed from the competitive mode, and learning becomes more self-learning. In this situation, people can easily exchange information and data with each other or form groups to carry out their own research and projects (9). If one knows that several trees are cut down to prepare pamphlets, books, and daily notebooks, he/she will undoubtedly become a fan of e-learning. One of the most serious reasons for the importance of the virtual education system is to help preserve the environment by reducing traffic, air pollution, and the amount of paper used. By using this educational method, we will also help to preserve our environment in addition to benefiting from all the above benefits (10). Another issue that is important regarding virtual and electronic education, especially for learners at younger ages, is the structure of the family in terms of computer literacy; access of families to electronic audio-visual facilities; ; economic, geographical and social status of families and the family's attention to the importance and necessity of virtual education and accepting this educational system instead of traditional and face-to-face education. There is much room for discussion and research (9).

One of the reasons for the importance of virtual education for students is that this method will not limit the class capacity. All face-to-face classes and courses have a limited capacity for the number of students. It is natural that each classroom has a certain capacity, and the high number of people reduces the quality of education to a great extent. E-learning also solves this problem and holds online classes without the limitations of face-to-face classes (11). In the online training course, students try to improve their skills and technical knowledge of using educational tools such as computers. Also, in this method, they should use different learning management programs and software, which will improve their software and technical skills (12). For this reason, educational institutions are inclined to use new educational approaches, including virtual education. In the educational system, the issue of improving the academic and curricular level and academic progress of learners is one of the main concerns of designers and policy makers in the field of education, and their academic success is assumed as one of the important bases for the continuous improvement of educational quality, which helps to identify some bottlenecks and problems of the education system and providing scientific and suitable solutions (13).

Therefore, it is necessary to examine the success and academic performance of students to understand the current situation and improve it and facilitate educational decision-making. (14). On the other hand, virtual education is a type of educational technology that is based on values such as being person-centered, independent learning, and self-directed and active process. Of course, each society applies this type of learning according to its specific social and cultural conditions. In the education system of Iran, the implementation of virtual education was officially started in 1380 with the efforts of both public and private sectors. In this issue, the important point is that the confrontation of the traditional method of education with the virtual education method has changed the educational outcomes of the learners, but the new culture of learning without the presence of a teacher cannot be easily applied; as a result, the new environment of teaching

and learning is associated with challenges (15). The research results show that for the development of online education in schools and its enrichment, effective factors, limitations, and challenges in the design of the electronic learning environment must be well identified to choose suitable solutions to speed up the development process of virtual training (16).

In his research, Esposito divides the problems of enriching virtual learning by teachers and in schools into two categories: external problems towards teachers (access, time, support, resources, and training) and internal problems towards teachers (attitudes, beliefs, activities, and resistance) (17).

Hooper and Hanafin's research also shows that structural and organizational factors such as funding and lack of up-to-date technology facilities are among the obstacles in the use of computers by teachers (18); others include hardware and software facilities, lack of trained manpower in the field of computer use; lack of clarity of goals in the field of computer use in education; low motivation due to not providing enough training to teachers and students; gender inequality among students in terms of access to computers; lack of familiarity with English; and lack of a valid scientific model.

Also, Xu found in his research that the use of information technology was directly influenced by the feeling of the usefulness of the information technology and personal factors. On the other hand, according to professors' and teachers' opinions, communication with learners and their active participation is an important motivating factor for learning (19). Therefore, problems such as the lack of creativity and new ideas, teachers' lack of technology knowledge, and lack of motivational factors are among the obstacles to the educational experience of virtual teachers. Also, not having deep conversations, not being understood by others, not having reciprocal understanding and recognition of others, and not having modeling and learning are the other limitations of online teaching-learning (20).

Higher online teaching efficiency by completing online courses (21), teaching preparation qualifications (22), and long-term flexibility of educational systems (23) are the other factors of recognition of the century for the effectiveness of virtual education.

Although many studies have been conducted in the field of virtual and electronic education and learning, there is not any research that examines the enrichment of online learners' teaching-learning experiences to achieve all the main goals of education and training. The present study compiled the model and tested it by combining the results of previous studies to achieve a more comprehensive explanation of the constructivist learning environment (Figure 1).

Methods

Study Design

In this correlational study, we used structural equation model (SEM)

Participants

The statistical population of this research consisted of two groups; the first group comprised experts (school principals and education experts and teachers). The second group consisted of male high school students of Kerman city, which according to the preliminary statistics were 1157 individuals.

Inclusion criteria: All high school females aged 13-15 years who had a smartphone, ability to work with the Internet, and willingness to participate in the study, expertise in the field of technology and education, and experience of at least 10 years of activity and teaching. People who refused to continue cooperation or did not answer more than 20% of the questions were excluded.

Data Collection Tools

A) Questionnaire of effective factors in enriching the online teaching-learning process

A researcher-made questionnaire was used to measure the factors affecting the enrichment of online education. To create

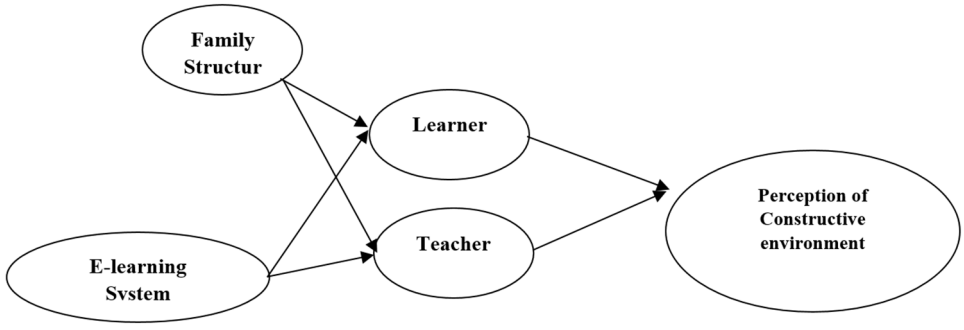

Figure 1: Conceptual model of research

this questionnaire, first, the effective factors were identified based on the theoretical and practical basis of the research and with the Delphi method and exploratory factor analysis. To measure these factors, we developed questions based on the identified factors. After examining the opinions of the experts, at the end of 45 questions, we formed the final form to be implemented in the final sample group (principals, teaching assistants, and teachers). The questions were scored based on a 5-point Likert scale from completely disagree to completely agree and the scores ranged from 1 to 5.

Validity: In order to check the face validity of the questionnaire, some experts such as the supervisor and the consultant confirmed the quantity and quality of the questions in the questionnaire.

In order to determine the content validity of the questionnaire, we gave the questions to 14 educational psychologists, and they were asked to answer each of the questions using "it is necessary", "it is not necessary, but it is useful", and "it is not necessary". The answers were calculated based on the CVR formula and adapted to the Lawshe table. Numbers higher than 0.59 were accepted. After determining and calculating CVR, content validity was checked based on Waltz and Base's CVI. For this purpose, the questionnaire was again given to 14 experts and they were asked to comment on each of the three criteria: relevance, simplicity, and clarity. Then, the content validity index was calculated based on the formula CVI. The acceptance of the items was based on the CVI score higher than 0.79. The total average was reported 0.80.

After the findings were obtained from the experts' opinions regarding the importance of each of the identified factors, they were evaluated and analyzed through the Delphi method. Then, to conceptualize, formulate, and analyze the factors identified in the Delphi method, we used the method of exploratory factor analysis. Exploratory Factor Analysis Reveals Key Dimensions and Sub-Factors in enriching the online teaching-learning process. The results of the EFA showed that the questionnaire had a good fit to the data, as indicated by the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett's test of sphericity. The KMO value was 0.82, which exceeded the recommended threshold of 0.6, and the Bartlett's test was significant ($\chi 2=2345.67$, df=990, $P<0.001$), indicating that the correlation matrix was not an identity matrix. The EFA extracted four factors that corresponded to the four main dimensions of the questionnaire, and each factor had several sub-factors that were loaded on it. The four factors explained 62.3% of the total variance. The titles of the components are given in Table 1. Delphi method and factor analysis were used for analysis of the data.

Reliability

Questions related to each component along with reliability coefficients are reported in Table 1.

Definition and Measurement of Variables

The definition of conceptual and operational variables for the two questionnaires are as follows: Questionnaire of effective factors in enriching the online teaching-learning process:

Table 1: Dimensions of the questionnaire factors affecting the enrichment of education and reliability coefficients

Dimensions	Questions	Cronbach's alpha
Capability of the educational system	1-17	0.77
Teacher competence	18-27	0.74
Learner competence	28-37	0.81
Family structure	38-45	0.80
Overall scale	-	0.75

• The main conceptual variable is the enrichment of online education, which is defined as the improvement of the quality and effectiveness of online teaching and learning processes by considering various factors that influence them.

• The four sub-conceptual variables are the capability of the educational system, teacher competence, learner competence, and family structure, which are defined as follows:

• Capability of the educational system: The extent to which the educational system provides adequate resources, infrastructure, policies, and support for online education.

• Teacher competence: The extent to which the teachers have the necessary skills, knowledge, attitudes, and motivation to facilitate online education.

• Learner competence: The extent to which the learners have the necessary skills, knowledge, attitudes, and efficacy to participate in online education.

• Family structure: The extent to which the family environment influences the learners' online education in terms of media literacy, interaction, possibilities, and attitude.

• The operational variables are the 45 questions that measure these sub-conceptual variables on a 5-point Likert scale. Each question is a specific and observable indicator of the underlying sub-concept. For example, question 1 asks "The educational system has a clear vision for online education" as a way of measuring the capability of the educational system. Questionnaire of perception of constructivist learning environment:

• The main conceptual variable is the constructivist learning environment, which is defined as a learning environment that fosters the active and collaborative construction of knowledge by learners based on their prior experiences and perspectives.

• The seven sub-conceptual variables are authentic learning, teacher facilitation, problem-centeredness, self-assessment, encouraging teamwork, attention to standpoints, and emphasis on previous learning, which are defined as follows:

• Authentic learning: The extent to which the online learning activities are based on real-world problems and situations that are relevant and meaningful to the learners.

• Teacher facilitation: The extent to which the teachers provide guidance and feedback to the learners in online learning without imposing their own views or solutions.

• Problem-centeredness: The extent to which the online learning activities involve problem-solving and inquiry-based learning that challenge the learners to think critically and creatively.

• Self-assessment: The extent to which the learners can

set their own goals, monitor their own progress, and reflect on their own results in online learning.

• Encouraging teamwork: The extent to which the online learning activities promote cooperation and collaboration among learners through communication and interaction tools.

• Attention to standpoints: The extent to which online learning activities respect and consider different views and opinions of learners in challenging activities within the framework of their belief system.

• Emphasis on previous learning: The extent to which the online learning activities connect with the prior knowledge and experiences of learners and build on them.

• The operational variables are again the 45 questions that measure these sub-conceptual variables on a 5-point scale. Each

question is a specific and observable indicator of the underlying sub-concept. For example, question 6 asks "The online learning activities help me understand different perspectives on a topic" as a way of measuring the attention to standpoints component.

B) Questionnaire of perception of constructivist learning environment

To measure the perception of the learning environment, Haghayeghi and Karsheki's questionnaire (24) was used. This questionnaire has 45 questions and measures components such as authentic learning, teacher facilitation, problem-centeredness, self-evaluation, encouraging teamwork, attention to standpoints, and emphasis on previous learning. The face validity of the questionnaire was confirmed by the supervisor and the consultant. Questions are scored on a 5-point scale: never (1), rarely (2), sometimes (3), often (4), and almost always (5). In Haghayeghi and Karsheki's study (2014), the reliability coefficient of the questionnaire was obtained through Cronbach's alpha (0.89) and for the components between 0.51 and 0.82. In the present study, the internal consistency of the questionnaire for the whole scale (0.78), for the genuine learning component (0.74), for the self-evaluation component (0.72), for facilitation (0.70) and the problem-oriented component (0.75) was obtained. Also, the results of the corroborative factor analysis confirmed the existence of the main factor structure.

Sample Size

The Method of Sampling and Determining the Sample Size

The statistical population of this research consisted of two groups: the first group comprised experts (school principals and education experts and teachers). In the interview section, the first 25 people from technology officials (2 people), educational assistants of the administration (3 people), school managers (4 people), school secretaries (4 people), teachers (4 people), and representative of the association of parents and teachers of schools (4 people) were selected and semi-structured interviews were performed. Then, in the quantitative and validation of research tools and models section, for the first group (expert), 150 people were selected using a convenience sampling method. Schumacher (2004; quoted by Ghasemi, 2018) used the ratio of the sample size to the observed variables to determine the sample size (25). He states that the minimum ratio is five to one, the average limit is 10 to one, and the upper limit is 35 to one. Accordingly, 35 people were considered for each observed variable. According to the 5 variables observed (final structural model), the sample size was 175 people. Given the possibility of dropout, the questionnaires were administered to 175 students, and at the end, after removing the incomplete questionnaires and screening the data, 150 questionnaires were analyzed.

Statistical Analysis

For the analysis of the data, descriptive statistics such as mean, standard deviation and inferential statistics, including exploratory factor analysis and confirmatory factor analysis were used. Also, to fit the conceptual model of the research, we applied structural equation modeling (SEM) using AMOS20 software.

Results

The mean±SD of the experts and teachers' age were 37±7.50 years, and those of the students' age were 13±2.25. Table 2 shows demographic features of the students' participants.

Table 3 shows the average and standard deviation of the scores of the sample group in the variables investigated in the research.

The results of Table 3 show that the mean and standard deviation of the research variables are higher than the average.

Structural Model Evaluation

Structural Equation Modeling (SEM) was used to determine the adequacy of the model proposed in this study. The results obtained from fitting the initially proposed

Table 2: Demographic characteristics of the students' participants (N=120)

Variable		Number	Percentage
	Seventh	62	41.34
Grade	Eighth	53	35.33
	Ninth	35	23.33
	First	56	37.33
Order of birth	Second	33	22
	Third and more	61	40.67
	High school and less	27	18
Father's education	Diploma	36	24
	BS	59	39.33
	MS and more	28	18.67

Table 3: The mean and standard deviation of research variables (N=150)

Variable	Mean	The standard deviation	Kurtosis	Skewness
Psychological	34.33	2.97	-0.42	-0.253
Attitude	26.47	3.80	0.156	-0.290
Media literacy	29.26	3.19	0.171	0.153
Efficacy	23.87	3.56	0.162	-0.666
Media literacy	27	4.06	0.074	0.631
Interaction	10.64	4.26	0.053	-0.698
Possibilities	2.47	0.94	0.002	-0.899
Attitude	2.74	0.92	-0.11	-0.931
Infrastructure	2.70	1.02	-0.252	-1.07
Efficient staff	7.92	2.00	0.096	-0.505
Education	9.28	2.50	-0.316	-0.537
Participation	8.49	2.92	-0.048	-0.351
Motivating	17.78	3.45	-0.181	-0.661
Access level	21.37	4.08	-0.363	-0.317
Teaching skills	13.64	2.94	0.272	-0.417
Media literacy	22.29	3.62	0.066	-0.421
Authentic learning	21.78	3.12	0.016	-0.525
Self-assessment	79.05	7.79	0.297	-0.647
Problem-driven	18.86	3.75	0.131	0.234
Facilitation	21.87	4.89	0.444	0.377

model showed that the data did not fit well with the model. The results obtained from fitting the initially proposed model showed that the data did not fit well with the model. To achieve a better fit, we removed the family structure path from the ability of the teacher, and in the next steps, the covariance of errors in the components of attitude and efficiency in the construct of the learner and the teacher's teaching and media literacy skills were added to achieve the desired fit (Figure 2).

Table 4 shows the results of fitting the initial and final hypothetical models with the data.

According to the contents of Table 4, all the presented indicators show the complete fit of the presented model. According to the contents of Table 4, in the final model, the ratio of the chi-square to the degree of freedom or the relative chi-square was 2.747, the goodness of fit index (GFI) was 0.945, the adjusted goodness-of-fit index (AGFI) was 942 0.0, the incremental fit index (IFI) was 0.952, the Tucker-Lewis index (TLI) was 0.935, the normalized fit index (NFI) was 0.927, and the root mean square error (RMSEA) was 0.044.

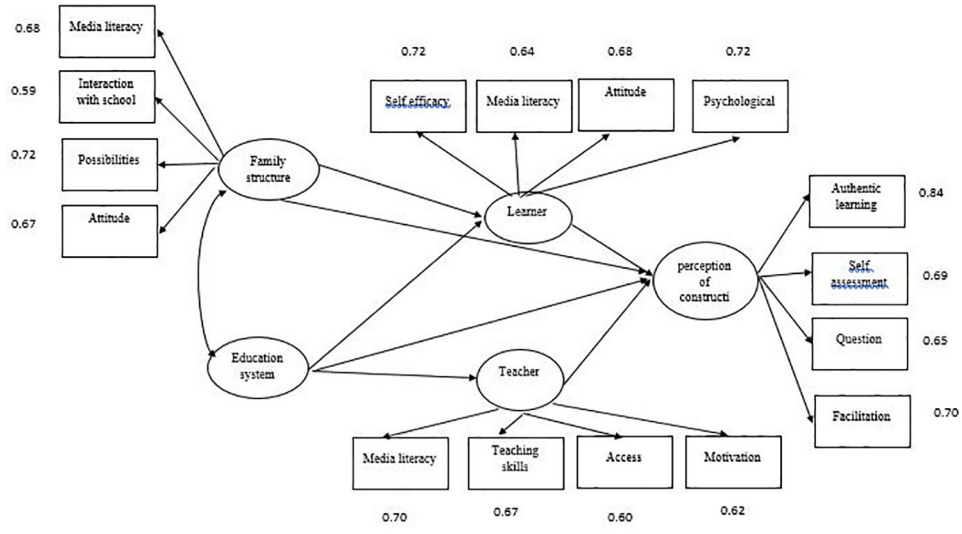

Figure 2: Final research model along with standard path coefficients

Table 4: Fitting the proposed model and the final model with the data based on the fit the indices

Indicators	x^2/df	GFI	AGFI	IFI	TLI	CFI	NFI	RMSEA
Proposed model	14.19	0.842	0.742	0.760	0.714	0.758	0.752	0.121
Final model	2.747	0.945	0.942	0.952	0.935	0.852	0.927	0.044

Table 5: Indirect effects of variables

Affiliated. Independent	Indirect effect	Standard error	P
On perception from constructive perspective From the family structure through the competence of the learner (student)	0.45	0.174	0.002
On perception from constructive perspective From the ability of the educational system (school) through the competence of the learner (student)	0.18	0.052	0.001
On perception from constructive perspective From the competence of the educational system (school) through the competence of the teacher (teacher)	0.26	0.075	0.002

Indirect Coefficients of the Structural Model

Table 5 shows the test of hypotheses regarding the indirect effects of the variables. In this Table, the indirect coefficients, significance level, standard error of estimation, and total effect are reported for the investigated paths.

Discussion

The findings of the research in the field of the proposed model showed that, by modifying the route, the final model had a good fit and was a significant predictor for the perception of the constructive environment. Although in the background of the research, no similar model or competing model was found for comparison, regarding the association between the family structure and the educational environment with the abilities of the learner and the teacher, the findings support the results of previous research in Iran (12, 20). They have confirmed the role of the family and the educational system in the perception of learning.

Approaches related to social capital were used for the theoretical explanation of the compiled model. Wright and Fitzpatrick defined social capital in the family as family support networks, intimacy, closeness, and informal links of family members with each

other, which is the level of participation of two partners, trust, awareness, and monitoring and provision of the prerequisites for emotional and cognitive development and the necessary facilities in this field (13).

Also, as Wright and Fitzpatrick (2006) defined social capital in school, it includes the facilities and conditions that the school provides for education, the connections of teenagers with each other, their attachment and sense of belonging to the school, and their participation in social educational, art and sports associations (13). The expected limit for each index was 0.67. The value obtained by the researchers was 0.99.

The school is referred to as a second home. Most of the students enter school upon entering school age and spend most of their time in the school environment after the family environment. The school environment has an undeniable impact on the future of education, career, and in general all aspects of children and teenagers' lives. A school is a social institution where students from families belonging to different subcultures and ethnic groups study together (23). Of course, since in modern and industrial cities, families live in different neighborhoods, according to their socio-economic base, and in each school, most students living in the same neighborhoods are enrolled, the range of differences is reduced. However, the school is a conduit to enter the general community. Teaching families about online education, facilities of the educational system (Internet, etc.), the level of skill of teachers in working with virtual space and virtual platforms, the facilities that the family provides to the student, teachers' teaching skills, families' attitude to virtual education, students' motivation to study, coordination between family and school, teacher's teaching method, and students' freedom and activeness in online education have been pointed out. Providing learning content based on the goal in different formats and related links, as well as giving learners the right to choose the time, place and speed of learning and matching with different learning styles (flexibility and adaptability) are also special features of electronic learning environments that Arane refers to as quality education in these environments (14).

The expected limit for each index was 2.0, and a large amount of this arrangement and similar works were done by Hong and Gao (10), indicating that e-learning normative consciousness and behaviors and self-efficacy played significant and mediating roles between the students' perceived family support and e-learning engagement. Specifically, these two individual variables fully mediated the relationship between students' perceived family support and e-learning engagement.

If the virtual learning environment is considered as a system, the high importance of this factor, compared to other important factors, can be easily understood due to the role it can play in providing the desired inputs for the activity of the system. The first factor that can be effective in providing a quality educational product or service in a learning environment is its inputs, which are prepared by the management of the educational system, which, along with the provision of the required resources, can ensure quality and infrastructure. Fallahi et al.'s study (2017), in line with the results of this research, shows that the infrastructure factor and system quality are the most important factors affecting the success of virtual learning (26).

In general, parents play an important role in their children's lives, especially their academic lives, and they are one of the most important elements that can have a direct impact on their learning. Changing the teaching method from face-to-face to virtual and online education due to the global corona pandemic has been one of the most challenging educational events in recent years. This change in learning style has placed more responsibility on the shoulders of parents, and now families are considered one of the most basic and important foundations of virtual education in the country. Since it is not possible to physically attend the class in the virtual education method and each learner learns at home, the space experienced by each of them may be different. An important task

that parents have is to bring the space and environment of the home as close as possible to the classroom environment and keep it calm at least until the end of the virtual class. In fact, the atmosphere that families create at home during virtual education is very effective in the teaching and learning process, as well as proper educational planning. The educational role of parents is another task that they must perform during virtual education. Parents should encourage learners to use the virtual method and, along with teachers and teaching staff, learn to use the technological facilities that are required to master this new educational method and teach their children and increase their media literacy; also, for planning, which is the most basic pillar of virtual education, they should have a detailed and codified plan for their children and to some extent control and supervise them, so that learning is done in a good way and prevent children from wrong dependence on the virtual space (10).

Limitation and Suggestion

The current research had some limitations. The evaluation of the criteria is based on the opinions of experts and e-learning specialists, which are self-reported and may be biased. Also, since the previous studies were limited to identifying the quality criteria of online education and did not prioritize them, it is not possible to directly compare the findings of the study with another research.

Conclusion

Based on the findings of the present research, it is suggested that the criteria identified in the research should be used as a basis for formulating the evaluation criteria for the quality of education in virtual learning environments; in the design and management of various processes of the online learning system, authorities should consider empowering various dimensions related to this system including students, teachers and families; designing and managing various processes of the online learning system; keeping in mind the empowerment of various dimensions related to this system, namely knowledge, learner, teacher, and family.

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Authors' Contribution

LK, MK, ZZM, AMT devised the study concept, designed the study, supervised the intervention, data collection and analysis, participated in the coordination of the study, and critically revised the manuscript. LK, MK, ZZM, AMT collected the data, ran the study intervention, participated in the study concept, performed the analyses and revised the manuscript. LK, MK, ZZM, AMT contributed to the design and analysis of the study data, and drafted the manuscript.

Conflict of Interest: None declared.

Ethical Consideration

This study was approved by the Ethics Committee of Islamic Azad University of Kerman (IR.IAU.REC.1400.027). The research samples were obtained with the written knowledge and consent of the people, and in the meantime, there was no risk for the participants; the ethical principles were observed during the research, and the methodology of the research,was based on our university rules and regulations.

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Original Article

The Impact of Social Networks on Enhancing Safety and Efficacy Outcomes in Low-Dose Rituximab Treatment for Central Nervous System Demyelinating Diseases

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ABSTRACT

Background: In the realm of healthcare, the symbiotic relationship between social networks and medical advancements has attracted significant attention. This study aimed to explore the effectiveness and safety of this approach, with a particular focus on the role of social networks in disseminating information and shaping patient experiences.

Methods: In a prospective single-arm interventional study, we examined the effects of integrating social networks – Skype and WhatsApp – to enhance the safety and efficacy outcomes of low-dose Rituximab treatment for CNS Demyelinating Diseases. Patients eligible for treatment were recruited, and ethical consent was secured. The intervention involved informative Skype groups, led by medical experts, providing education and follow-up, and WhatsApp groups for peer support and question-answer sessions. Clinical data and interaction metrics were collected to evaluate treatment outcomes and engagement levels.

Results: A total of 99 patients received rituximab, with 42 diagnosed with RRMS, 43 with SPMS, and 14 with NMOSD. The treatment period ranged from 12 to 40 months. Among the RRMS patients, 8 (19%) experienced new attacks, while 10 (23%) of the SPMS patients and 1 (7%) of the NMOSD patients had new attacks. In cases of RRMS and NMOSD, there was a decrease in EDSS scores. Additionally, SPMS and NMOSD patients showed a decrement in serum IgG levels. Two cases of drug adverse events were reported. Mean EDSS variability had a decrease in RRMS (-0.32, P=0.06) and NMOSD (-0.57, P=0.004) and had a slight increase among patients with SPMS (+0.19, P=0.23).

Conclusion: Recognizing the impact of social networks can lead to improved patient care and tailored support systems.

Keywords: Distance, Social networking, Teaching, Multiple sclerosis

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Introduction

Social media platforms have brought about a revolutionary change in how information is shared and communicated in today's interconnected world. Their impact goes beyond personal connections, extending into various domains, including healthcare and medical research (1). This introduction explores the intersection of social media and medical treatment, specifically focusing on how these platforms influence the safety and effectiveness of low-dose Rituximab treatment for central nervous system demyelinating diseases (2). The interplay between social media and medical progress highlights a significant shift in how patients, medical professionals, and researchers collaborate, exchange insights, and leverage collective knowledge to enhance treatment strategies and patient outcomes (3). This exploration sheds light on the multifaceted role of social networks in reshaping modern healthcare, transcending geographical barriers, and ushering in a new era of collaborative healthcare innovation (2, 4).

Central nervous system demyelinating diseases, such as multiple sclerosis (MS) and neuromyelitis optica spectrum disorder (NMOSD), present considerable challenges in their treatment and management (5, 6). The use of low-dose Rituximab, a monoclonal antibody targeting B cells, has emerged as a promising therapeutic avenue for these conditions (7). However, the complex nature of these diseases requires ongoing research, careful monitoring of treatment results, and the sharing of practical insights between healthcare providers and patients. This is where social media platforms play a pivotal role (8).

Social media provide a powerful platform for patients and healthcare professionals to exchange experiences, knowledge, and observations related to treatment protocols, side effects, and overall treatment effectiveness (1). Online communities and forums dedicated to demyelinating diseases have sprung up on platforms like Facebook, Twitter, and Reddit, creating virtual spaces for individuals to engage in open discussions about their journeys. These platforms, often guided by patient advocates and medical experts, serve as digital hubs for the exchange of knowledge, fostering a sense of empowerment and solidarity among patients navigating their conditions (3).

In the context of low-dose Rituximab treatment, insights shared by patients on social media platforms offer invaluable information that complements formal clinical research (9). Patients' personal accounts of their responses to treatment, experiences with side effects, and strategies for coping can be crucial in identifying the patterns and nuances that traditional clinical trials might overlook. While this data might lack standardization, it provides a broader view of treatment outcomes, shedding light on individual variabilities and enabling more personalized treatment approaches (6, 10).

Additionally, social media facilitates a direct communication between patients and healthcare professionals, breaking down traditional hierarchies and enabling a collaborative approach to treatment (11). Patients can seek advice, seek clarifications, and even challenge established norms, while healthcare providers can provide guidance, share evidence-based information, and adjust treatment plans based on real-time feedback. This participatory approach empowers patients to be active participants in their healthcare journey and promotes a patient-centric approach to medical practice (12).

Beyond individual interactions, social media platforms also bridge geographical divides among researchers and medical experts. Virtual conferences, seminars, and academic discussions eliminate the constraints of physical gatherings, expanding access to the latest research findings. Collaborative research endeavors involving experts from around the world can be facilitated through these platforms, accelerating the generation of new knowledge and the translation of research into practical treatment strategies (12, 13).

However, the convergence of social media and medical insights comes with its challenges. The reliability of information

shared on these platforms can vary widely, from well-informed expertise to anecdotal claims lacking scientific basis. The objective of this study was to investigate the influence of social networks on improving safety and efficacy outcomes in the context of low-dose Rituximab treatment for central nervous system demyelinating diseases.

Methods

Study Design

The context of this article is a retrospective cohort study carried out at a sole tertiary center between the years 2016 and 2019.

Participants

Based on the results of the study by Zhao et al. (2023) (14), considering an approximate 2.5-point difference in anxiety scores between the intervention and control groups with a 95% confidence level and 80% power, a sample size of 90 individuals was calculated. In the study conducted by Zhao et al., the EDSS score was reported as 2.0 (with a range of 1.5–4.5) before receiving rituximab (Pre-RTX), and it significantly improved to 0 (with a range of 0–3.0) after receiving rituximab treatment (Post-RTX). Taking into account a 10% potential dropout rate and to increase power, we considered a minimum sample size of 99 individuals for each group. The sampling method used in this study was convenience sampling. Participants were selected from the patient population of a tertiary center, which probably refers to a specialized medical facility offering advanced diagnostic and treatment services.

The inclusion criteria encompassed patients diagnosed with MS spectrum or NMOSD based on the McDonald's criteria for MS and the international consensus diagnostic criteria for NMOSD, respectively. Patients with anti-myelin oligodendrocyte glycoprotein (anti-MOG) demyelinating disease spectrum diagnosis were excluded from the dataset.

Our protocol for managing patients with MS spectrum and NMOSD follows a specific approach when it comes to disease-modifying drug (DMD) selection. Rituximab is not initially considered as the first-choice DMD for these conditions. Instead, it is reserved for cases where patients have shown a poor response to first-line therapeutic agents. First-line therapies commonly include medications such as interferon β or dimethyl fumarate for MS. These medications are typically prescribed as the initial course of treatment for patients with MS spectrum and NMOSD. However, in situations where patients do not experience significant improvement or have a suboptimal response to these first-line agents, rituximab may be recommended as an alternative. The decision to prescribe rituximab as a second-line DMD is based on individual patient characteristics, clinical evaluations, and the assessment of treatment effectiveness. By reserving rituximab for cases with a poor response to first-line therapies, our protocol aims to optimize treatment outcomes and tailor therapeutic approaches to the specific needs of each patient with MS spectrum and NMOSD. According to our common practice in our center, the patients receive 500 mg rituximab per dose, ("Zytux" ARYOGEN Co, Tehran, Iran) by slow intravenous infusion over a 4-hour period. We administered rituximab in two separate courses, two-weeks apart and these two doses were repeated every 6 months to restrain the disease from further attacks. As premedication, patients received methyl prednisolone (125 mg intravenous infusion), chlorpheniramine (10 mg intravenous stat), and acetaminophen (1000 mg oral) 30 minutes before the administration of rituximab, to inhibit any possible inflammatory reactions.

Data Gathering

In this retrospective cohort study, we utilized the hospital electronic health records system to extract patient data including Demographics, clinical, radiological and lab data of patients with DDCNS treated in a single tertiary center in the years 2016-2019. Based on expert diagnosis, patients were divided into three sub-groups: RRMS, SPMS, and NMOSD. MS and NMOSD were

diagnosed based on McDonald's criteria 2010 and international consensus diagnostic criteria for neuromyelitis optica spectrum disorders 2015 (15, 16), respectively. Patient demographics, such as age, gender, and other relevant information, were extracted from the Electronic Health Records (EHR) System. Clinical information pertaining to the patients' medical history, disease type (RRMS, SPMS, NMOSD), and expert diagnoses were gathered from the EHR records. Radiological data, including results from the brain, cervical, and thoracic contrast-MRIs, were collected to assess the presence of new lesions and disease progression. Laboratory results, specifically serum immunoglobulin G (IgG) levels, were extracted to monitor changes over time. Information about the treatment regimen, including the administration of rituximab infusions, dosages, and intervals, was retrieved from the EHR system. Data from the patients' close follow-up of at least 12 months after receiving 4 infusions of rituximab were collected. There was no patient with an anti-myelin oligodendrocyte glycoprotein (anti-MOG) demyelinating disease spectrum diagnosis in our data set. During the follow-up period, neurological evaluation and laboratory tests were routinely performed every six months for all patients after the first course of rituximab. Neurological disability status was assessed by the expanded disability status scale (EDSS), and any change in EDSS during the follow-up was assessed for patients in each group. Moreover, the number of new attacks during treatment (relapse) and any infusion-related adverse effects of rituximab were also documented.

Skype Groups for Education and Follow-up

Upon recruitment, the participants were enrolled in virtual Skype groups that consisted of a maximum of 10 individuals per group. These groups were facilitated by neurologists and nursing staff specializing in CNS Demyelinating diseases. The Skype sessions were conducted every two weeks for the initial three months and then transitioned to monthly sessions for the subsequent three months.

During these sessions, participants were provided with comprehensive explanations about the low-dose Rituximab treatment process, potential side effects, and strategies to manage them. The sessions also allowed the participants to share their experiences and concerns. Individualized follow-ups were conducted to monitor the treatment progress, address any emerging issues, and tailor guidance as needed.

WhatsApp Groups for Peer Support and Question-Answer Sessions

Participants were also added to WhatsApp groups, organized based on their treatment start dates. These groups fostered peer-to-peer support and engagement. Participants were encouraged to share their experiences, ask questions, and provide insights related to their treatment journey.

Weekly question-answer sessions were organized, during which participants could post their queries and concerns. Medical experts, including neurologists, nurses, and pharmacists reviewed these questions and provided evidence-based answers. This platform encouraged interaction and collaboration among the participants and medical professionals.

Social Network Interaction Data

Interaction data from Skype sessions and WhatsApp groups were collected, including the frequency of participation, questions asked, and discussions contributed by each participant. This data provided insights into the engagement levels and the topics of interest within the patient community.

Data Analysis

To investigate the role of social networks in the treatment outcomes of low-dose rituximab, we incorporated a social network analysis component into the methodology. In addition to the clinical data collection, we identified relevant online and offline social networks frequented by patients with demyelinating diseases of the CNS. These included patient forums, social media

groups, and local support groups. Data related to the participants' social network usage, interactions, and content shared within these networks were collected using surveys and Web scraping techniques. The collected data underwent analysis, and p-values were calculated using the Wilcoxon signed-rank test. To compare the differences between the groups (RRMS, SPMS, NMOSD), we used ANOVA to compare age, disease duration, and follow-up period between different disease groups. Additionally, all participants provided written informed consent for both rituximab treatment and participation in the study.

This retrospective cohort study was previously posted to the preprint (https://doi.org/10.20944/preprints202012.0705.v1) on December 28,2020.

Results

From February 2016 to December 2019, a total of 99 patients with RRMS, SPMS, and NMOSD underwent a prospective selection for rituximab therapy. Among them, 42 patients (42.5%) were diagnosed with RRMS, 43 patients (43.4%) had SPMS, and 14 (14.1%) were diagnosed with NMOSD.

The mean age of the patients was 39.5 g10.7 years (between 18 and 66). 67 patients (67.7%) were female. The groups were similar in their age and sex average, and no significant difference was found between the groups' demographics (P>0.05). Disease duration ranged between 2 to 30 (mean 8.97) years, and the mean follow-up for rituximab-therapy was 20.4±7.9 months (ranged 12 to 40). The number of attacks during treatment with rituximab was 8 (19%), 10 (23.2%) and 1 (7%) among patients with RRMS, SPMS and NMOSD, respectively. Among the 19 patients who had experienced attacks during the follow-up period, 13 had one episode, 4 patients had two episodes and 2 had experienced three episodes of attacks. The last EDSS was subtracted from the baseline EDSS for each patient. Mean EDSS variability had decreased in RRMS (-0.32, P=0.06) and NMOSD (-0.57, P=0.004) and had a slight increase among patients with SPMS (+0.19, P=0.23). New lesions on T2-weighted MRI and Gadolinium enhancing lesions were found in 9 and 4 cases respectively, during the follow-up MRI (Table 1). Serum IgG level had a declining trend in 13.9% and 10% of patients with SPMS and NMOSD, respectively. None of patients with RRMS had serum IgG decrement during the follow-up. There was no opportunistic infection in patients with low serum IgG.

Table 1: Patients' characteristics at first course of Rituximab administration and during the follow-up

Features	RRMS	SPMS	NMOSD
No. of patients, (%)	42, (42.5)	43, (43.4)	14, (14.1)
Age at presentation (years)			
Mean	34.1	43.5	43
Range	18-66	27-60	26-62
Gender, No. (%)			
Male	14, (33.3)	13, (30.2)	5, (35.7)
Female	28, (66.7)	30, (69.8)	9, (64.3)
Mean disease duration (years)	6.7	12.2	6
Mean follow-up period (months)	17.3	22.2	24.3
Patients with clinical attacks (proportion of that specific DDCNS , %)	8 (19)	10 (23)	1 (7)
New T2-weighted MRI lesions	4	4	1
Gadolinium enhancing lesion	2	2	0
Drug reaction	0	2	0
EDSS variability	-0.32±1.1 (P=0.06)	+0.19±1 (P=0.23)	-0.57±0.6 (P=0.004)
Serum IgG level	-	13.9%	10%

RRMS: Relapsing-remitting multiple sclerosis; SPMS: Secondary-progressive multiple sclerosis; NMOSD: neuromyelitis optica spectrum disorder; EDSS: Expanded Disability Status Scale

Table 2: Characteristics of patients who experienced new attack during the follow-up

No.	Age, Sex	Type	Localization of the lesion	Symptoms
1	42, female	SPMS	Pyramidal	Ambulation deficit
2	34, male	RRMS	Pyramidal & Sensory	Lower limbs weakness & paresthesia
3	35, female	RRMS	Cerebellum, Paraventricular & Cord	Ambulation deficit
4	53, female	SPMS	Cord	Paraparesis
5	29, male	SPMS	Pyramidal	Ambulation deficit
6	42, female	NMOSD	Pyramidal	Ambulation deficit
7	42, female	SPMS	Pyramidal	Hemiparesis
8	37, female	SPMS	Pyramidal & Sensory	Hemiparesis
9	39, male	SPMS	Periventricular	Hemiparesis & Paresthesia
10	38, female	SPMS	Pyramidal	Hemiparesis
11	32, female	RRMS	Pyramidal	Ambulation deficit
12	43, female	RRMS	Periventricular	Ambulation deficit
13	27, female	SPMS	Pyramidal	Hemiparesis
14	29, female	RRMS	Brain stem	Trigeminal neuritis
15	48, female	RRMS	Pyramidal	Ambulation deficit
16	30, female	RRMS	Cord	Paraparesis & Sphincteric disorder
17	44, male	SPMS	Pyramidal	Ambulation deficit
18	29, female	SPMS	Pyramidal	Ambulation deficit
19	20, female	RRMS	Pyramidal, Optic nerve & Cerebellum	Hemiparesis & Blurred vision

SPMS: Secondary-progressive multiple sclerosis; RRMS: Relapsing-remitting multiple sclerosis; NMOSD: neuromyelitis optica spectrum disorder

Adverse Drug Effect

During 818 administered doses of rituximab, only two cases had developed a drug adverse effect during or after rituximab infusion. These adverse effects included flushing and thrombocytopenia in two SPMS patients during and after rituximab administration, respectively. In the first case, a 40-year-old man developed flushing 30 minutes after starting the administration of the first dose of rituximab. There were no hives, itching, shortness of breath or hemodynamic changes. The infusion rate declined to half and the patient received the rest of the dose without any further complications. The second case, a 37-year-old woman, was diagnosed with thrombocytopenia after the second dose of rituximab during her routine tests (Table 2). Treatment was continued and she received the two subsequent doses six months after her first thrombocytopenic event. After the 4th course of rituximab administration, the platelets count dropped to 11.5×10^9/L but returned to the normal range during the next four-months close follow-up without further treatments.

Discussion

The role of social networks in the treatment of demyelinating diseases of the central nervous system (CNS) has gained increasing attention in recent years. This study endeavored to explore the effectiveness and safety of low-dose rituximab in the context of these diseases, with a particular focus on the impact of social networks on patients' experiences and outcomes.

Social networks, both online and offline, have emerged as valuable platforms for individuals living with demyelinating diseases to connect, share experiences, access information, and seek support. The findings highlight the significance of social networks in shaping the patients' treatment journeys and overall well-being (17). One important aspect of social networks is their ability to provide a sense of community and support (8). Through online patient forums, social media groups, and local support groups, individuals can connect with others facing similar challenges. These networks offer a platform for patients to share their experiences, exchange practical advice,

and provide emotional support. Engaging in these networks can contribute to a greater sense of empowerment and self-efficacy among patients, which can positively influence treatment adherence and self-management strategies. Moreover, social networks facilitate the dissemination of information. Patients can access a wealth of knowledge about their condition, treatment options, and emerging research findings through these networks. By tapping into the collective wisdom of the community, individuals can make more informed decisions about their treatment choices, engage in shared decision-making with healthcare providers, and advocate for their needs (18).

The results showed a favorable effectiveness of low-dose rituximab in patients with various forms of DDCNS. Given the results of our study, 80.8% of patients experienced a complete disease control without relapses; all of them had suffered treatment failure with other medications in the past. D'Amico et al. published a similar study of their experience in administration of rituximab in patients with DDCNS in Italy, in which 65% of their patients had no evidence of disease activity (7). Due to financial problems, we were not able to check CD19 and CD20 in all patients, but we used the total serum IgG level as an indirect marker of severe B cell depletion and to diagnose patients at the risk for infections secondary to immunosuppression. Our experience shows that close following of these markers is not necessary to ensure effectiveness and safety of rituximab therapy. This may further rationalize the implementation of low-dose regimen in similar situations, when the routine monitoring of CD19 and CD20 is not available. Besides safety, our results showed that the efficacy of low-dose treatment is non-inferior to high dose protocol, and there were no infection-related complications in our patients. Although the reliability of IgG monitoring merits further investigations, we recommend routine monitoring of total serum IgG in similar situations, as it is a much more available and inexpensive laboratory test compared to flow cytometry. In similar studies, follow-up through CD19 and CD 20 monitoring neither reached higher disease control nor faced less adverse events compared to our present results (19-21). The higher effectiveness of rituximab in disease-relapse-control, although it is biased by a small number of patients (one relapse in 14 NMOSD patients), is supported by those studies which used rituximab as first-line DMD for NMOSD and have reported significant relapse control and reduction in EDSS as well as appropriate tolerability (22, 23).

The integration of social networks into healthcare has the potential to significantly impact patients' knowledge and awareness, leading to improved health outcomes. In the context of demyelinating diseases of the central nervous system (CNS), such as multiple sclerosis and neuromyelitis optica spectrum disorders, social networks play a crucial role in disseminating information, sharing experiences and fostering support among patients (24, 25).

One of the primary benefits of social networks is their ability to provide access to a vast pool of health-related information. Patients can join online communities, patient forums, and social media groups specifically dedicated to demyelinating diseases. These platforms allow individuals to connect with others who share similar medical conditions and engage in discussions about symptoms, treatments, and management strategies. Through this exchange of information, patients gain valuable insights and firsthand experiences, empowering them to make more informed decisions about their health (26).

Furthermore, social networks create opportunities for patients to interact with healthcare professionals, patient advocates, and researchers. Online Q&A sessions, webinars, and live discussions enable the patients to pose questions directly to experts, clarifying doubts and dispelling misconceptions. This direct engagement with healthcare experts can lead to a deeper understanding of their condition and treatment options, ultimately improving patient adherence to prescribed therapies and management plans (27).

Limitation

The reliance on social media data introduces potential biases, including self-selection bias and limited control over data accuracy. Additionally, the retrospective nature of the cohort study might limit causal inferences. Variability in the quality and relevance of information shared on social networks also presents a challenge.

Suggestion

Our findings offer a promising foundation for further investigation into the integration of social networks in enhancing treatment outcomes for central nervous system demyelinating diseases.

Conclusion

Ultimately, this study underscores the potential influence of social networks on shaping patient experiences and treatment outcomes in the context of low-dose Rituximab therapy for central nervous system demyelinating diseases. By integrating insights from both clinical assessments and social media interactions, we reveal a multifaceted perspective on safety and efficacy. The notable findings signal the transformative role of digital platforms in enhancing personalized patient care and support systems. As the healthcare landscape continues to evolve, these insights pave the way for innovative strategies to optimize treatment outcomes and foster patient well-being.

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None to declare.

Authors' Contribution

All authors (MN, MM, JH, ME, MA, NM, EA, PS, SAH, MM, MM, SN, and HN) conceptualized the study, and all were major contributors to writing the manuscript. All authors approved the final manuscript.

Conflict of Interest: None to declare

Ethical Considerations and Participants Consent

The ethics committee of Iran University of Medical Sciences approved this study (IR.IUMS.FMD.REC 1396.9511158003). This research was conducted with the consent of the participants. They were also assured that all information collected would remain confidential. The authors declare that they have no conflict of interest.

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Original Article

Enhancing the Students' Academic Motivation and Learning Achievement through the Flipped Classroom Approach: An Educational Intervention

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ABSTRACT

Background: Academic motivation is a fundamental aspect of learning that provides intensity and direction to a learner's behavior. In recent years, the flipped classroom teaching method has gained popularity as a pedagogical approach that aims to enhance student learning outcomes and engagement. This study aimed to compare the efficacy of flipped Classroom Approach on elementary school students' academic motivation and learning achievement.

Methods: An educational interventional study employing a pretest-posttest design was conducted with an intervention and a control group. The study enrolled sixty eligible students who were studying in two elementary schools from August to December 2021. They were randomly allocated to intervention (flipped classroom approach, n=30) and control (traditional method, n=30) groups. To measure academic motivation, we used the standardized questionnaire, the Harter Academic Motivation, which consists of 33 questions. Also, for measuring the learning achievement, we developed a 20-item multiple-choice questionnaire. Data were analyzed using IBM SPSS v 22.0. Multivariate analysis of covariance (MANCOVA) was performed. P-value<0.05 was considered as the significance level.

Results: The mean learning achievement and academic motivation scores in the intervention groups increased more than that the control group significantly (P<0.001). In contrast, in the control group, no significant changes were observed (P>0.05). Additionally, the outcomes demonstrated a significant increase in academic motivation scores among the flipped classroom group, particularly in the areas of preference for challenging academic tasks, focus on students' curiosity, tendency towards independent mastery, and preference for easy work subscales, compared to the control group (P<0.001). The study did not find significant improvements in other areas of extrinsic motivation, such as satisfaction with the instructor or achieving grades, and reliance on the teacher's evaluation.

Conclusion: According to the results, flipped classroom approach can improve the students' learning achievement and academic motivation regarding science.

Keywords: Distance, Learning achievement, Flipped classroom, Academic motivation, Elementary school students

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Introduction

Educational strategies are influential factors in learning levels and academic motivation (1). In recent years, the flipped classroom teaching method has gained popularity as a pedagogical approach that aims to enhance the student learning outcomes and engagement (2). The flipped classroom approach involves providing students with instructional materials, such as videos or readings, to review out the class time, and then using class time for interactive and collaborative learning activities facilitated by the teacher (3).

Therefore, students can learn at their own pace and in a way that is tailored to their individual needs (4). This approach also promotes greater collaboration among students as they work together to solve problems and share their knowledge. With the teacher acting as the designer and manager of classroom activities, the flipped classroom creates a flexible learning space that is independent of time and place. In addition, by adopting this innovative teaching method, students are not only able to achieve better academic results, but they also develop a greater sense of motivation and engagement in their learning (5, 6).

Academic motivation is a fundamental aspect of learning that provides intensity and direction to a learner's behavior (7). It plays a crucial role in helping the learners maintain their interest and continue their learning journey (8). With this motivation, individuals are inspired to take the necessary steps to successfully complete a task, achieve their goals, or attain a certain level of competence in their work. Ultimately, this leads to success in their learning and academic progress (9).

Several studies have investigated the impact of the flipped classroom on students, including its impact on learning outcomes (10), creativity (11), various learning outcomes (12), academic progress (13), academic motivation (14), student satisfaction, and retention of knowledge. Research has shown the effectiveness of the flipped classroom as a teaching technique for enhancing learning achievement and academic motivation in students. Nonetheless, in contrast to the findings from certain other research studies, no notable distinction was observed between traditional and flipped classrooms (15, 16). In addition, the majority of the studies mentioned above have concentrated on examining the effects of the flipped approach on particular aspects of the learning process. Further research on the effectiveness of teaching using the flipped classroom can shed light on the importance of using this method in the education process. With this in mind, we aimed to determine whether teaching based on the flipped classroom is effective in improving the learning achievement and academic motivation of elementary school students in Shiraz, Iran.

Methods

Study Design

Between August and December 2021, a pretest-posttest educational intervention study was conducted with two groups: an intervention group that used the flipped classroom approach, and a control group that followed traditional classroom methods.

Participants

Eligibility Criteria for Participants

The inclusion criteria for the study were all fourth-grade students enrolled in a male-only elementary school in Shiraz, Iran, during August-December 2021. This decision was made to maintain homogeneity in the study groups, as it is a cultural norm in Iran and provides easier access to participants. Only students who were willing and able to participate in the study and were not guest students during the semester were included in the study. Those who were unwilling to continue their cooperation were excluded from the study.

Teaching Interventions

The intervention includes preparing teaching materials, choosing an approach, and implementing it. An e-learning specialist and an educational technology student with 10-

20 years of teaching experience collaborated to develop content and train the students in science. The learning objective of this course was to develop the students' learning about science and educational motivation. The educational content was derived from the Iranian Textbook for fourth grade of elementary school for science subject.

After completing the pretest, the intervention group received access to the Learning Management System (LMS) and eight weeks of multimedia content for their lessons, consisting of written, visual, and audio materials tailored to a teaching scenario. The multimedia content was created using the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model (3). The interactive content included questions with embedded options that allowed the learners to receive necessary feedback from the system. Correct answers kept the learners on the main track of the lesson, with additional information provided to enhance their knowledge, while incorrect answers led to sufficient explanations and the supplementary information section. One week before each in-person class, multimedia content for the next session was delivered to students, who were asked to study the content and email the generated code at the end of the lesson to their teacher after completing the lesson and answering inter-lesson questions.

In total, eight two-hour in-person classes were held over eight weeks, with instructors providing learning goals, short presentations, and open-ended questions. Participants engaged in small-group discussions to find the answers, with the instructors acting as facilitators, guiding and encouraging individuals to participate.

In the control group, traditional teaching methods (lecture, question-and-answer, and group discussion) were used with the same flipped classroom content available in the intervention group. It is worth mentioning that in both methods, the teacher and educational content were the same. One week after completing the training, participants in both groups completed the posttest, and at the end of the study, educational content was made available to the control group.

Data collection tools*:* The students' level of learning and motivation was assessed both before the training sessions began and again one week after they completed the sessions. The data collection tool consisted of:

Demographic information: Demographic information included the students' age and the educational and economic levels of their parents.

The Harter Academic Motivation: The questionnaire was developed by Harter in 1981 as a standardized tool to measure academic motivation in students. It contains 33 items that assess both intrinsic (n=17) and extrinsic (n=16) motivations. Intrinsic motivation is characterized by an inherent desire or interest in learning and is made of three factors: Preference for Challenge (engaging in academic activities because they are challenging and stimulating), Curiosity/Interest (engaging in academic activities because they are interesting and arouse curiosity), and Independent Mastery (engaging in academic activities to learn and develop mastery in the subject matter). Extrinsic motivation, on the other hand, refers to external factors that motivate a student, such as rewards or grades. The extrinsic motivation subscale consists of three items: Preference for Easy Work Assigned (the extent to which students are motivated by work that is perceived as manageable or not too challenging), Pleasing the Teacher/ Getting Grades (the extent to which students are motivated by the desire to please their teacher or obtain good grades), and Reliance on Teacher's Judgment (the extent to which students are motivated by their teacher's feedback or evaluations to succeed academically). To assess the level of intrinsic and extrinsic motivation, the questionnaire employs a five-point Likert scale that ranges from 1 (completely disagree) to 5 (completely agree).

The questionnaire has been found to have high internal consistency, with a Cronbach's alpha coefficient of 0.92 for the intrinsic

motivation subscale and 0.84 for the extrinsic motivation subscale. The Harter academic motivation questionnaire has been found to have good construct validity (17).

Learning achievement: To collect data on students' learning of science, the researchers developed a questionnaire consisting of 20 multiple-choice questions. The internal consistency of the test questions was examined for each question, and an acceptable consistency was obtained. The face and content validities of the questionnaire were evaluated by 20 specialized teachers who were familiar with test construction, and it was found to be valid. The questionnaire had a content validity index (CVI) of 0.80 and a content validity ratio (CVR) of 0.92. It also showed good reliability, with a Cronbach's alpha coefficient of 0.83.

Sample Size and Randomization

The researchers conducted a pilot study and determined a power of 84% and a confidence level of 95% (α=0.05) for their analysis. Based on these findings, a sample size of 30 was calculated for both intervention and control groups. Permission was obtained from the Education Department to conduct the study in two schools to prevent information transfer between the students. The schools were selected for their convenient accessibility to the researchers, with one school using the flipped classroom method and the other school using traditional teaching methods. By the use of a simple random table, 30 students were randomly assigned to each group in either school.

Statistical Analysis

The data were examined using descriptive and analytical statistical tests in IBM SPSS v 22. To evaluate the effect of the intervention, we performed independent T-test, paired T-test and analysis of covariance (ANCOVA). P-value<0.05 was considered as an acceptable significance level.

Results

60 students were selected using convenience, and those who met the criteria

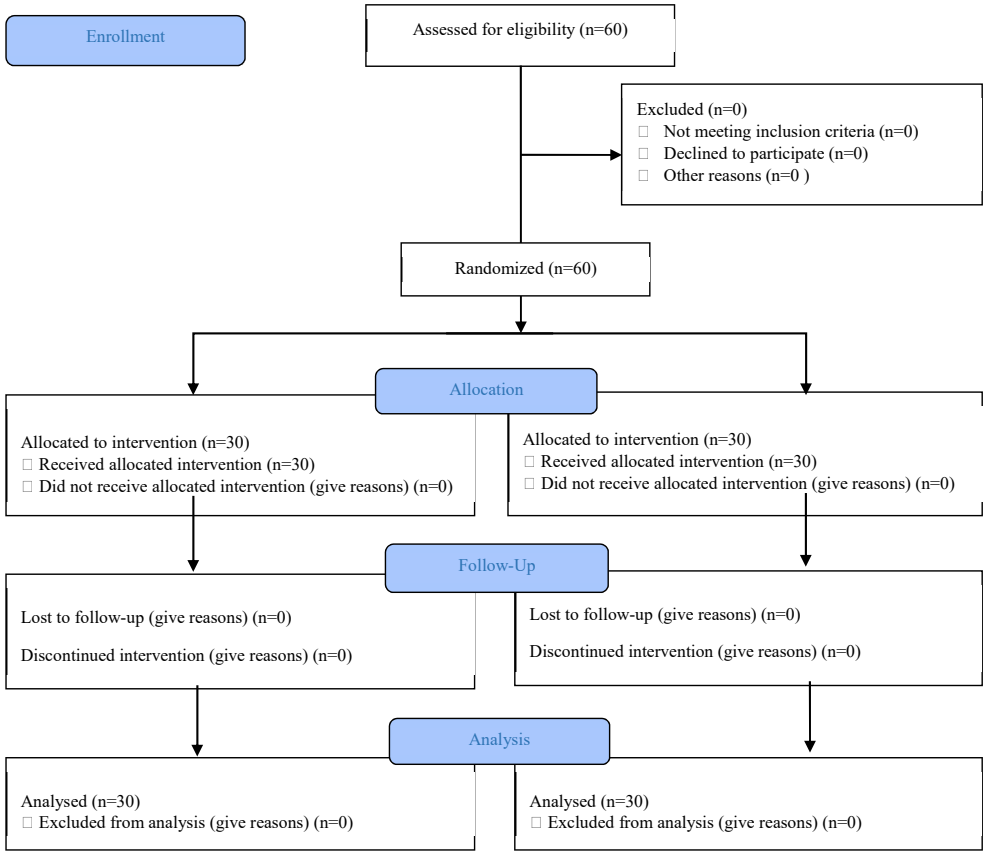

Figure 1: The student's recruitment flow diagram.

were randomly assigned using a simple random table. The study used a "Chi square" test to analyze the frequency distribution of age and the educational and economic levels of their parents. The results indicated that there was uniformity between the two groups, with a p-value greater than 0.005. The participants were divided into two groups, intervention and control, using a "parallel" design, as shown in Figure 1. The intervention group received flipped classroom, while the control group received traditional method. All of the participants who were randomly assigned successfully finished the study and the follow-up evaluation.

The learning and academic motivation scores in the intervention and control groups were evaluated and compared before and one week after the intervention (Tables 1 and 2).

As shown in the table above, the mean±SD of learning achievement scores before the intervention were 14±5.60 and 14±5.42 in the intervention and control groups, respectively, with no statistically significant difference (P=0.99). However, after the training, the level of learning achievement scores in the flipped classroom group increased compared to the control group (18±4.60 versus 15±5.90, P=0.03).

The mean±SD of academic motivation scores in the intervention and control groups were 108.48±12.73 and 107.43±12.03, respectively, with no statistically significant difference (P=0.74). However, after the training, the level of academic motivation scores in the flipped classroom group increased compared to the control group (124.03±11.33 versus 108.01±11.99, P<0.001). Overall, the results indicate that the flipped classroom had a significant effect on the learning and academic motivation of elementary students (P<0.001 and P<0.001).

The impact of the flipped classroom on different dimensions of academic motivation, including Social Information Processing, Social Awareness, and Social Skills, as well as emotional intelligence, such as intrapersonal skills, coping with stress, adaptability, and general mood is shown in Table 3.

Before the intervention, there were no significant differences between the flipped classroom and control groups in any of the subscales or total scores for academic motivation, as shown in the table above. However, after the intervention, the mean scores for students' intrinsic motivation in the flipped classroom group increased significantly in the areas of preference for challenging academic tasks, focus on students' curiosity, and tendency towards independent mastery as opposed to the control group (P<0.001). In terms of extrinsic motivation, the preference for easy work had a positive and significant effect on students in the flipped classroom group (P<0.001), while no significant differences were observed in other

Table 1: Within- and between-group Comparison of the Learning Achievement Scores in Intervention and Control Groups before and after the Educational Intervention

Intervention Group	Control Group Mean±SD	Flipped classroom Mean±SD	Between-group comparison
Pre-test	14±5.42	14±5.60	0.99
Post- test	15±5.90	18±4.60	0.03
Within-group comparison	0.29	<0.001	---

Table 2: Within- and between-group Comparison of the Academic Motivation Scores in Intervention and Control Groups before and after the Educational Intervention

Intervention	Control Group Mean±SD	Flipped classroom Mean±SD	Between-group comparison
Pre-test	107.43±12. 03	108.48±12.73	0.74
Post- test	108.01±11.99	124.03±11.33	<0.001
Within-group comparison	0.80	<0.001	---

Table 3: Within- and between-group Comparison of the Academic Motivation Subscale Scores before and after the Educational Intervention

Dimensions	Sub-Dimensions		Control Group Mean±SD	Flipped classroom Mean±SD	P value
Intrinsic Motivation	Preference for Challenge	Pre-test	26.93±4.61	27.90±4.35	0.40
		Post- test	27.03±4.73	31.66±3.99	<0.001
	Within-group comparison		0.90	<0.001	---
	Curiosity/Interest	Pre-test	9.53±3.13	9.05±3.11	0.55
		Post- test	9.89±3.25	11.20±2.87	0.10
	Within-group comparison		0.54	<0.001	---
	Independent Mastery	Pre-test	15.86±2.79	16.80±2.99	0.21
		Post- test	15.97±2.55	19.33±2.30	<0.001
	Within-group comparison		0.82	<0.001	---
Extrinsic Motivation	Preference for Easy Work Assigned	Pre-test	22.93±3.83	21.66±3.73	0.20
		Post- test	22.74±3.89	28.54±3.01	<0.001
	Within-group comparison		0.79	<0.001	---
	Pleasing the Teacher/ Getting Grades	Pre-test	18.93±3.78	18.66±3.39	0.77
		Post- test	18.74±3.71	18.54±3.18	0.82
	Within-group comparison		0.78	0.84	---
	Reliance on Teacher's Judgment	Pre-test	107.43±12.02	108.48±12.73	0.74
		Post- test	108.01±12.73	108.01±11.99	0.99
	Within-group comparison		0.80	0.83	---

areas of extrinsic motivation, such as Pleasing the Teacher/Getting Grades and Reliance on Teacher's Judgment. This suggests that our intervention had a beneficial effect on these aspects of academic motivation.

Discussion

The aim of this research was to investigate how the flipped classroom approach impacts the academic motivation and learning achievement of elementary school students. The findings revealed that this method had a significant positive effect on the students' learning level. Moreover, the results showed that the score for the academic motivation in the flipped classroom group significantly increased in preference for challenging academic tasks, focus on students' curiosity, tendency towards independent mastery, and preference for easy work subscale compared to the control group.

The flipped classroom approach can lead to better academic performance due to several reasons. Firstly, it enables the students to learn at their own pace and in a self-directed manner, which can enhance their engagement and motivation (18). Secondly, it provides the students with more resources and support outside the classroom, such as online lectures, videos, and interactive activities (3). Thirdly, it encourages active learning and collaboration during class as students have already been exposed to the material beforehand and are better prepared to participate in discussions and problem-solving activities (19). Lastly, it facilitates a deeper comprehension of the subject matter, as students have the opportunity to review and revisit the material as many times as necessary to fully grasp the concepts (20).

This educational program incorporated several factors to increase the students' academic motivation in a functional format. Initially, instead of traditional lectures in the classroom, students learned the course material through instructional videos and images at home. After learning the material, a virtual and face-to-face environment was provided for group discussions, which led to a more enjoyable learning experience and better achievement (5, 6). This approach allowed the students to move away from repetitive teaching methods and provided them with an exciting way to learn course material and participate in class, resulting in increased motivation to complete assignments and attend classes on

time (21). Furthermore, the program provided the students with a considerable amount of freedom and autonomy in learning the course material, thereby enhancing their ability to learn independently. (22). Undoubtedly, this factor stimulated the academic motivation of the students and raised their level of engagement. Overall, the implementation of these factors significantly enhanced the students' academic motivation and led to better academic performance.

Other studies in this area also highlight that training using the flipped classroom method can have a significant effect in comparison to traditional methods by enhancing the students' learning outcomes (23), engagement (13), self-efficacy (24), and attitude (25).

The study revealed that the implementation of the flipped classroom approach had a significant positive impact on the students' intrinsic academic motivation, as measured by various subscales. Specifically, students in the flipped classroom group exhibited a higher preference for challenging academic tasks, indicating their willingness to take on difficult assignments and challenges in their coursework (26). Also, these students showed a stronger focus on their curiosity, indicating a greater desire to learn and explore new ideas. The flipped classroom approach also resulted in an increased tendency towards independent mastery, as students became more likely to take ownership of their learning and strive towards mastering course material on their own. In this regard, a study conducted by academic motivation demonstrated that flipped classrooms can be particularly effective in enhancing the students' intrinsic motivation, which is driven by their own interest and enjoyment of the learning process (27). In addition, the flipped classroom approach resulted in an increased preference for easy work, which is a subdimension of extrinsic motivation. This finding suggests that students found the learning experience more engaging and enjoyable, which may have contributed to their increased motivation (28). However, in this study, there was no significant relationship between Pleasing the Teacher/Getting Grades and Reliance on Teacher's Judgment with the students' academic motivation.

The results of this study suggest that intrinsic factors are more strongly related to students' academic motivation than extrinsic factors such as desire to please the teacher or receive high grades. This is because intrinsic motivation is driven by an individual's inherent interest and enjoyment of a task, while extrinsic motivation is driven by external factors such as rewards or punishments. Moreover, when students feel that they have a sense of control over their learning and are supported in their efforts, they are more likely to feel motivated and engaged in the learning process. In contrast, a focus on pleasing the teacher or achieving good grades may create pressure and anxiety, which can detract from students' intrinsic motivation to learn (27, 28). Overall, these studies suggest that creating a supportive, autonomous learning environment that fosters intrinsic motivation is key to promoting the students' academic motivation and engagement. Overall, these findings suggest that the flipped classroom approach can be an effective way to enhance the students' academic motivation and engagement.

Limitation and Suggestion

A limitation of the present study is the relatively small number of participants. Therefore, the authors recommend that future research should investigate the flipped classroom using a larger sample size to enhance the generalizability of the findings.

Conclusion

In this study, it was found that the level of learning and academic motivation was higher among the group that used the flipped approach compared to those who used the traditional method. Consequently, based on these findings, it is recommended that the flipped approach should be adopted for better learning outcomes and academic motivation.

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Authors' Contribution

NZ and GS devised the study concept, designed the study, ran the study intervention, data collection and analysis, participated in the coordination of the research, writing and critically revised the manuscript. All authors have read and approved the content of the manuscript.

Conflict of Interest: None declared.

Ethics Approval and Participants Consent

The present study was approved by the local ethics committee of Shiraz University of Medical Sciences (decree code: IR.SUMS.REC.1398.894). Following ethical principles, the researchers explained the aims, methods, and conditions of the study to the participating, and written informed consent was obtained from them. Participants were assured of the confidentiality of their data, and that only general statistics would be presented.

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Interdisciplinary Journal of Virtual Learning in Medical Sciences

Original Article

Acceptance of Gamified Web-Based Education in Mental Illness Courses: A Survey of Medical Students' Perceptions Over 5 Years

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ABSTRACT

Background: Gamified learning can make students more focused and can lead to learning at a deeper level. The aim of this study was to investigate the students' perceptions of gamified web-based learning. In this study, we aimed to find out the students' viewpoints about the dimensions of gamification acceptance and their correlation to each other.

Methods: This survey study was conducted in 2022 on 350 students of Public Health, Medicine, and Laboratory Science who had taken three courses in mental health, health psychology, and mental health and addiction, and were taught through gamified learning between late 2017 and 2021. *The Game Acceptance Questionnaire* was used in this study. The questionnaire consisted of 21 questions divided into seven components: *Perceived ease of use*, *Perceived usefulness*, *Perceived enjoyment*, *Perceived control, Concentration, Attitude towards using, and Behavioral intention*. Each component had three questions. The Likert scale was used in this questionnaire, with a range of 5 to 1, where 5 means strongly agree and 1 means strongly disagree. The cut-off point was 3. Content validity and face validity were examined by experts and students. The reliability of the instrument, as measured by Cronbach's alpha, was 0.872. Data were analyzed using IBM SPSS Statistics V22.0.

Results: The highest mean scores were related to attention to play (4.15±0.64), concentration during play (4.03±0.59), attitude towards playing as a good idea (4.025±0.65), ease of learning (3.99±0.70), and interesting gamification (3.96±0.74). Students' perspectives did not differ significantly by the field of study. Differences in the acceptance of gamification components were significant by gender only in the field of enjoyment (P=0.02).

Conclusions: The use of gamification is an emerging technology in many countries, including developing countries, and useful and practical information about it can facilitate its expansion and proper use.

Keywords: Gamified learning, Game acceptance, Gamification, Medical students, Mental health course, Medical education

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Introduction

The entry into the third millennium has confronted man with challenging phrases such as the century of speed and change, or the age of information and communication. It is an era that is considered as a powerful platform and tool that can have a tremendous economic, social, cultural, and political impact (1). Recently, with the development of e-learning system, the issue of mobile learning has received more serious attention among the managers of educational systems (1, 2). Integration of information and communication technology with the educational process facilitates the communication of learners, accessing a wide range of learning resources, providing an appropriate curriculum to the needs of learners, ensuring equitable opportunities for all learners, and promoting social and cultural communities through wireless Internet access (3, 4).

One of the most important challenges for teachers is to create motivation and active learning in students. Accordingly, teaching and learning methods could be divided into passive and active (5). Game and playing is one of the active educational methods, and it seems that the gamified learning can make students more focused; it also leads to much deeper learning. Research has shown that gamified educational design has a positive effect on improving the knowledge, performance, and attitude of students. Gamified learning, which is also referred to by other words such as gamification (6, 7), serious game, and gamification, means the use of game elements in non-game environments (8). Of course, the specific definition of each of these concepts differs in some applications, but what is commonly used in most of the articles related to the use of games in education is the more common term gamification and includes other meanings as well. The important point is that gamification does not mean making a game with the purpose of entertainment, and basically its main purpose is education and learning, which is done with a gamified educational design approach (8, 9).

The use of emerging methodologies such as digital game and gamification has revealed great potential in improving the teaching and learning processes (10, 11). Proponents of game learning argue that computer games have the potential to change college education, motivate, and engage the new generation, what the traditional education lacks. Gamification can revolutionize college education because it increases the students' motivation and engagement (12). Students' motivation to learn, and ability to learn and play skills can be key factors that affect the acquisition of knowledge through digital gamification (13). In the literature, various elements of the game have been used in education, including points, point, badges, rewards, leaderboard, and feedback (8, 9, 14, 15). Also, more than 108 elements of gamification are known, which can be effective in creating interest and motivation in learning, but three main elements of *Points, Badges* and *Leader* are three common and essential elements in gamified learning (14). In general, gamification and gamified learning is a relatively new approach in e-learning that has increased with the development of new technologies, and some studies have also pointed to the effectiveness of this approach (16-18), but more studies are still needed.

Based on the studies, various models and methods have been used worldwide to examine the factors affecting the adoption of information technology; one of their most authoritative one is the Technology Acceptance Model (TAM), which examines the factors at the individual level. Technology acceptance is a structure that consists of cognitive and psychological elements about the use of technology (19, 20). All these models aim to understand the factors that affect the effective use of technology. Among these models, the TAM is the most popular and widely used one in studies related to computers and Internet technologies (21-23). Designed and developed by Davis (1989), the TAM measures the individuals' willingness and intention to use technology based on three elements: perceived usefulness, perceived ease, and behavioral intent to use (20, 24).

Venkatesh et al. Developed the Integrated Acceptance and Use Model theory. This model incorporates similar elements in eight different models (social cognition theory, innovation diffusion theory, technology acceptance model, planned behavior theory, hybrid technology acceptance model and planned behavior theory, motivational model, personal computer use model, and the theory of rational action which combines "hope for performance, hope for effort, facilitation, and social influence" as the four basic elements that determine behavioral intent for use (25). Given the importance of educational gamification and its importance in student learning, it seems that different models have a role in the adoption of game-based technology in education. Educational computer games are increasingly seen as a promising tool to illuminate the students' learning motivation. They provide a scenario-based learning environment in which users gain knowledge or skills from the game (26). They not only provide a virtual learning space to users, but also enable them to play an active role in learning, which is why they are more effective than traditional educational tools in motivating students to learn (27). In addition, these types of games often require the user to perform a challenging task, so that the users can also develop their problem-solving ability (28, 29) and by mastering the subject of their learning through the process as a strengthened practitioner (30, 31). In addition, users in this case are no longer passive recipients of knowledge from their teachers, but active knowledge makers (32) who, thus, achieve meaningful learning. Hence, educational computer games have attracted the attention of many researchers and have been introduced in many fields. Studies have also shown that educational gamification, when equipped with appropriate learning strategies, will improve the students' learning effectiveness (25, 33). The study by Robson outlines the definition of gamification and suggests an initial framework based on key psychological theories, including the theory of self-determination and intrinsic and extrinsic motivation (34).

One of the courses offered for many medical science disciplines at Jahrom University of Medical Sciences is "Mental Illnesses Courses." This course has been run using a gamification approach and through the Web for students for a period of 5 years. The diverse nature of courses related to psychology and mental health aligns well with the gamification method, and over the course of a long period, many students have received education through this approach. Although theories and past research confirmed the effectiveness of gamification on student learning, due to the novelty of this learning method, it is necessary to further investigate and research the acceptance of this technology-based education. Especially in web-based gamification, students are alone in the learning environment and learn individually, so it is necessary to investigate whether they have a pleasant experience with this type of education and whether this method can meet their learning needs. Therefore, the present study aimed to investigate the acceptance of gamified web-based education in mental illness courses from the medical student's perceptions.

Methods

Design and Setting

This research has been done in 2022 by survey method on students of Jahrom University of Medical Sciences, who used gamified web-based learning in three courses of mental illnesses during the 2017-2021.

Participants

The statistical population of the present study included all students of Public health, Medicine, and Laboratory sciences who in the period of late 2017 to 2021 had taken three courses related to mental illnesses) Mental health, Health psychology and Mental health and addiction) and were taught in a gamified approach.

Sampling

For estimating the required sample size

for this research, the Cochran formula can be used. Given that the number of students who used the web-based gamified learning method between 2017-2021 was 350 (N), with an alpha level of 95%, error level of 0.05, and a Z-value of 1.96, the minimum sample size was estimated to be around 184 students. It is worth noting that in this formula, due to the lack of previous similar research, the values of P and Q were considered 0.5.

$$n = \frac{\frac{z^2 pq}{d^2}}{1 + \frac{1}{N}\left[\frac{z^2 pq}{d^2} - 1\right]}$$

However, since the questionnaire was sent electronically to the students, and the possibility of sample dropout in the electronic method is very high, an email containing a questionnaire link was sent to 250 students, and ultimately, 227 students fully responded to the questions.

Tools/Instruments

At the end of each course, the students were asked to answer an online questionnaire. To conduct the research, we used the TAM Questionnaire used by previous researchers including Liao & Huang (2015) (24), The questionnaire consists of 21 questions in seven components: *Perceived ease* of use, *perceived ease* of use, *perceived usefulness*, *perceived enjoyment, Perceived control, Concentration, Attitude towards using, and Behavioral intention*, with 3 questions in each area. In this questionnaire, a Likert scale from 5=strongly agree to 1=strongly disagree was used, and score greater than 3 meant accepting the desirability of the gamified learning (24, 35). The questionnaires were sent online to the students after the end of the academic term to gather their opinions.

Validity and Reliability: Validity and reliability of the questionnaire have previously been approved by previous studies (24, 36, 37) but because this questionnaire was translated, face validity was examined through the perspectives of 5 students and 10 educational experts in the field of e-learning, medical education and educational management after translating the questionnaire. Grammar problems were corrected. Also, the content validity of the questionnaire was re-examined by the Content Validity Index, for which the views of 10 educational experts were used. In the content validity index, experts were asked to determine the degree of relevance of each item in three areas of relevance, simplicity, and clarity with the four-part spectrum. Finally, the number of experts who chose options 3 and 4 were divided by the total number of experts. If the value was less than 0.70, the item was rejected. If it was between 0.70 and 0.79, a review should have been performed, and if it was greater than 0.79, it was acceptable (38). In reviewing the opinions of 10 experts, except for the three questions, the rest of the questions had an agreement score of more than 85%. Two questions had a lower score than the simplicity index, which were finally approved by more than 0.80 after correction. The reliability of the instrument was confirmed again with 30 samples and 21 questions by internal consistency analysis of questions with Cronbach's alpha 0.87.

Gamification of Content: In total, two gamified courses named mental illness with the link Psychiplay.ir (Figure 1) and addiction with the link Addiplay.ir (Figure 2) were designed. The scientific content of these courses was in the two topics of mental illness and addiction prevention, which were presented in three courses of mental health and addiction, Health psychology, and General psychology for three groups of students majoring in Health, Medicine, and Laboratory Sciences.

Mental illness topics (Psychiplay.ir web-bases gamification) included 13 stages about the signs and symptoms of mental illness and mental disorders. Addiction course topics (Addiplay.ir web-based gamification) also included the type of substance abuse, complication and using, and prevention and treatment. The scientific content of the course was based on the approved curriculum in the field of mental health and addiction prevention. It was developed and endorsed by the psychology and psychiatric nursing department.

Figure 1: View of the first page of gamified web-based training of Psychiplay.ir

Figure 2: View of the first page of gamified web-based training of Addiplay.ir

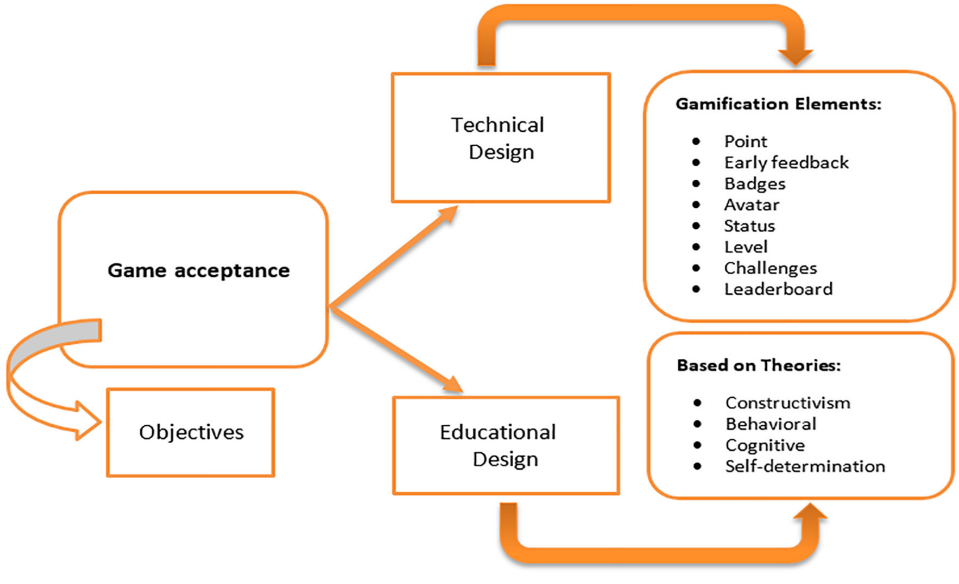

Figure 3: Gamification elements, concept, and process

According to the theories and researches, there are more than 108 elements of gamification known, but *Points*, *Badges*, and *Leaderboards* are considered as the most important elements commonly used in gamification and have been found to be effective in promoting engagement and motivation in learners (14). Finally, the gamified design of both courses was based on web-based questioning, along with elements of Point, Early feedback, Badges, Avatar, Status, Level, Challenges, and Leaderboard.

Figure 3 shows the educational and technical design and elements used in two gamified courses (Figure 3), and Table 1 shows their features (Table 1):

Data Analysis

Data were analyzed by IBM SPSS Statistics V22.0 using one-sample t-test, independent t-test, ANOVA, and Pearson correlation coefficient.

Results

Based on the research findings in the two web-based gamifications, 227 students answered the online questionnaire completely. In total, most of the 97 students (42.7%) were studying medicine, 120 (52.9%) of them were male, and their mean age was about 20.6 years. The demographic characteristics of the students are shown in Table 2.

Acceptance and desirability gamification training: Figure 4 shows that the highest mean is related to the concentration and attitude towards using components, respectively, and the lowest is related to perceived control and perceived enjoyment. Based on the results of one-sample t-test and comparison of mean comments, all components had a score higher than the cut-off-point and in all components P value was <0.001 (Figure 4).

Table 3 shows the average of each item. In the comparison of items, the highest mean was related to attention to play (4.15±0.64), concentration during play (4.03±0.59), attitude to play as a good idea (4.025±0.65), ease of learning (3.99±0.70), and interesting game (3.96±0.74) (Table 3).

Table 1: Titles of three courses about mental illnesses and the participants' groups

Field of Study	Courses	Duration	Number of Population	Number of Samples	Game Title
Medicine	Health psychology	2017-2021	201	97	psychiplay.ir (4 stage) addiplay.ir (4 stage)
Laboratory science	General psychology	2020-2021	84	73	psychiplay.ir (7 stage) addiplay.ir(8 stage)
Public health	Mental health and addiction	2019-2021	65	57	psychiplay.ir (4 stage) addiplay.ir (4 stage)
-		2017-2021	350	227	

Table 2: Demographic characteristics of the participants in the research

Demographic Characteristics		Frequency	Percent
Field of Study	Medicine	97	42.7
	Health	57	25.1
	Laboratory sciences	73	32.2
	Total	227	100.0
Gender	Male	120	52.9
	Female	107	47.1
	Total	227	100.0
Age	Minimum	19	
	Maximum	23	
	Mean±SD	20.6±1.45	

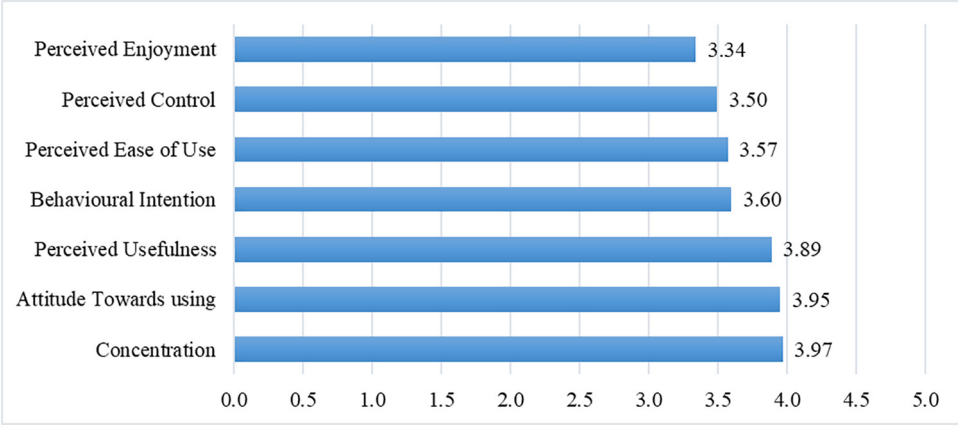

Figure 4: Average components of game acceptance from students' perspectives

Table 3: Average items of gamification acceptance from the students' point of view

Components	Items	Mean	SD
Perceived ease of use	It is easy for me to become skilful at playing the game.	3.44	0.52
	I think that the game is easy to play.	3.29	0.74
	Learning to play the game is easy for me.	3.99	0.70
Perceived usefulness	I think that the game is useful in assisting me with vocabulary learning	3.74	1.10
	I think that the game is useful in assisting me with vocabulary learning in a quick fashion.	3.96	0.95
	I can achieve greater learning effectiveness with the assistance of this game.	3.96	0.89
Perceived enjoyment	I find the game exciting.	3.34	1.30
	I find the game enjoyable.	3.26	1.31
	I find the game interesting.	3.42	1.23
Perceived control	I have full control over the proceeding of the game.	3.46	0.75
	I sense no confusion when playing the game.	3.45	0.82
	I feel no frustration when playing the game.	3.57	0.80
Concentration	I am completely engrossed in the game when playing it.	3.74	0.81
	I pay full attention to the game when playing it.	4.03	0.59
	I concentrate solely on the game when playing it.	4.15	0.64
Attitude towards using	I regard playing the game as a good idea.	4.02	0.65
	I find that the game makes learning more interesting.	3.96	0.74
	I prefer learning English vocabulary by using the game.	3.89	0.92
Behavioural intention	I am willing to play the game frequently.	3.82	0.83
	I am willing to recommend others to play the game.	3.54	1.06
	I am willing to repeatedly playing the game in the future.	3.44	1.00

Acceptance based on the field of study and gender: The investigation of students' perspectives by field of study did not show a significant difference, but the study of differences in the acceptance of gamification components from the students' perspectives by gender was significant only in the field of enjoyment (P=0.02), and no significant difference was observed in other areas (P>0.05). According to the results, the average component of enjoyable play was more in males than females (Table 4)

Correlation between the components of acceptance. There was a correlation between all components of acceptance. The highest correlation was related to Perceived enjoyment and Perceived usefulness (r=0.851), Attitude towards using and Behavioural

Table 4: Mean average of gamification acceptance from the students' perspectives by gender

Components	Gender	N	Mean	SD	P value
Perceived ease of use	Male	119	3.55	0.60	0.51
	Female	106	3.59	0.38	
Perceived usefulness	Male	119	3.89	1.07	0.99
	Female	106	3.89	0.71	
Perceived enjoyment	Male	119	3.52	1.46	0.02
	Female	106	3.13	0.90	
Perceived control	Male	119	3.48	0.65	0.67
	Female	106	3.52	0.41	
Concentration	Male	119	4.01	0.49	0.22
	Female	106	3.93	0.41	
Attitude towards using	Male	119	3.97	0.63	0.72
	Female	106	3.94	0.55	
Behavioural intention	Male	118	3.68	0.86	0.19
	Female	106	3.53	0.85	

Table 5: Correlation between gamification acceptance components

Components	Index	1	2	3	4	5	6	7	Total
1. Perceived ease of use	R	1							
	P value								
2. Perceived usefulness	R	0.588**	1						
	P value	<0.001							
3. Perceived enjoyment	R	0.402**	0.851**	1					
	P value	<0.001	<0.001						
4. Perceived control	R	0.243**	0.280**	0.289**	1				
	P value	<0.001	<0.001	<0.001					
5. Concentration	R	-0.003	0.025	0.030	0.182**	1			
	P value	0.959	0.705	0.651	0.006				
6. Attitude towards using	R	0.081	0.242**	0.280**	0.477**	0.405**	1		
	P value	0.226	<0.001	<0.001	<0.001	<0.001			
7. Behavioural intention	R	0.048	0.170*	0.224**	0.375**	0.423**	0.826**	1	
	P value	0.470	0.011	0.001	<0.001	<0.001	<0.001		
Total	R	0.511**	0.793**	0.801**	0.582**	0.357**	0.693**	0.646**	1
	P value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	

R: Pearson Correlation; *Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed).

intention (r=0.826), Perceived ease of use and Perceived usefulness (r=0.588), Attitude towards using and Perceived control (r=0.477), Concentration and Behavioral intention (r=0.423), Attitude towards using and Concentration (r=0.405), and Perceived ease of use and Perceived enjoyment (r=0.402). Comparing the correlation of each component with the total score, the results showed that the highest correlation of the gamification acceptance score was related to Perceived enjoyment (r=0.801), Perceived usefulness (r=0.793), Attitude towards using (r=0.693), Behavioural intention, respectively. (r=0.646) and Perceived control (r=0.582). (Table 5).

Discussion

In the present study, the average components of gamification acceptance, attention to play, focus while playing, tendency to play as a good idea, ease of learning, and interesting game were more than the others. Tao et al. utilized TAM and other theories to create a research model to identify the

factors influencing the students' intention to use career simulation games on an ongoing basis. Their results showed that the students' intention to continue using games is affected by their level of satisfaction and indirectly by its ease of use due to perceived play (38).

In the field of game acceptance, the present questionnaire, ease of use and satisfaction with its implementation was one of the important areas. Sense of control in playing games is one of the components that was addressed in the recent questionnaire and can be considered equivalent to understanding the usefulness. Perceived pleasure and perceived control are widely accepted as indicators of technology acceptance (35, 39, 40). The results of the above research are consistent with the extracted domains in game acceptance.

In some studies, other components have been mentioned. In a way, perceived pleasure is perceived as the extent of the impact of computer activity and control has been considered as a level of personal control over the environment and actions of the person (41). The focus component was one of the most important dimensions with higher averages. Lu, Zhou, & Wang (2009) used the flow of technology and other factors to measure the users' acceptance of instant messaging (42, 43). They found that perceived utility and perceived pleasure affected attitudes toward use, which in turn affected the behavioral intent. In the present study, the two components "Attitude towards using" and "Behavioral intention" had a positive relationship with each other. According to the results, the average component of enjoyable play was more seen in men than women.

The result of this study was confirmed in other studies (44). This study also showed that the use of gamified learning in information security education had increased their motivation in education and their field. Other studies have also confirmed this result (45).

In the present study, the mean of the components such as attention to the game, focus while playing the game, tendency to play as a good idea, ease of learning and the game were more interesting than the others.

Another study was conducted as a meta-analysis of Video Game Acceptance in the field of technology acceptance. The results of this study showed that perceived ease of use (PEOU), perceived usefulness (PU), and perceived enjoyment (PE) were significantly associated with attitude and had the maximum effect on attitude and motivation of individuals and their behavior. The mentioned factors had a high mean in accepting the gamification of the present study. Males enjoyed gamification more than females. Other components in all disciplines and both sexes had a high average (46).

Another study on the components affecting game acceptance for game learning acceptance showed that users' attention and motivation in learning through gaming was related to components of student PU, student satisfaction (SAT), and student habitual (HAB). On the other hand, satisfaction was related with students' PU. In the present study, usefulness was of important components in game acceptance. If we can consider the attitude to the game as a kind of satisfaction, we can consider the satisfaction component of the above-mentioned research in line with the current research (47).

Another study on the acceptance of technology by people using serious games showed that the perceived usefulness of the game and interaction of students were two components of the adoption of technology and learning tools (48). Other studies have found ease of use to be an important factor in accepting playing in teaching and learning. They also recommend using the game to support teaching and learning (49). Some studies have linked game acceptance to other factors such as playfulness and drowning. And this has been associated with a positive perception of the game (perceived playability) and doing it. This game was about acquiring communication skills through play. The above components in the present study also had an effect on game acceptance with the highest average (50).

It can be said that exposure to and immersion in the game helps to acquire skills

and affects learning. Utility, ease of use, and flexible environment are the important factors in using the game and accepting it in learning (51).

The above factors, with emphasize the flexible environment of the game, remind us of its simplicity, ease, and efficiency in accepting it. Game environment design, game manic, dynamics and interaction between the user and the environment, feedback, challenges, and advantages designed in the design can create a flexible and motivational environment, so that the user can use it to experience effective and deep learning.

Another study links people's experience of the game to acceptance and intrinsic motivation to do so. Major factors in acceptance and motivation were introduced in an article named "perceived usefulness of a game as a learning tool, perceived ease of use".

The mentioned cases and components consider the important role of the factors in the acceptance of the game as effective factors. The present study also pointed out the importance of these components with the highest average in game acceptance. Intrinsic motivation moves the person in a purposeful way, and paves the way for its effective use (52).

In the present study, there was a correlation between all game components and the highest correlation between perceived enjoyment and perceived usefulness (r=0.851), attitude towards using and behavioral intention (r=0.826), perceived ease of use and perceived usefulness, respectively. (r=0.588), attitude towards using and perceived control (r=0.477), concentration and behavioral intention (r=0.423), attitude towards using and concentration (r=0.405), and perceived ease of use and perceived enjoyment (r=0.402). Comparing the correlation of each component with the total score showed that the highest correlation of the game acceptance score was related to perceived enjoyment (r=0.801), perceived usefulness (r=0.793), attitude towards using (r=0.693), behavioral intention, respectively. (r=0.646) and perceived control (r=0.582).

In a study that aimed to investigate the relationship between the components of game acceptance and technology acceptance, the results showed that the relationship between the following was positive: Perceived ease-of-use and Attitude toward use, attitude toward use and Perceived usefulness, Attitude toward use and Intention to use, Intention to use & Actual use, Perceived usefulness, Social Influence Personal and Perceived ease-of-use, Enjoyment and Perceived ease-of-use, and Enjoyment and Perceived usefulness.

The relationship of some elements in this research is consistent with the correlations obtained in this realization. However, the component of social influence in the study and questionnaire of the present study was not discussed. However, the effect of the game and individual characteristics on the factors and the average obtained in it was obvious. The focus on the present realization and its relationship with other components in the above research and other studies can be considered with the attention and motivation to use the parallel game. Consistent relationship with other cases also indicates the effect of factors in all studies on game acceptance (53).

Another study showed that the amount of attention paid to serious play was related to the expectation of learning and its manifestation in performance. In the present study, the relationship between Attitude towards using and Behavioral intention was also positive. The more positive the attitude towards the game, the stronger its application in practice. This means that the person will be more willing to use it. The possible consequence will be a more effective effect on performance or learning (54).

Limitation and Suggestion

This research is the result of surveying the opinions of students over a 5-year period and therefore provides reliable results for educational planning. However, this research is based on gamification in an educational environment and was only conducted for courses with common mental health content, so it may have different results in different environments or different

courses. Therefore, it is recommended that this research be conducted in different environments and with different tools.

Conclusion

Based on research findings, web-based gamified learning has been an acceptable method for students' learning. Additionally, the relationship between the questionnaire dimensions and the total score shows that the enjoyable aspect of learning has the highest correlation with the total score. Therefore, it seems that gamified learning with a sense of enjoyment and engaging students can be an effective method of teaching.

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Authors' Contribution

LM participated in design and implementation of web-based gamification, design the intervention, data gathering, draft of primary manuscript, and editing final paper. MD participated in draft of primary manuscript and editing final paper. Z K Participated in writing manuscript, research design, data analysis and editing final paper. All authors confirmed final draft.

Conflict of Interest: None declared.

Ethical Issues

Written ethical approval was taken from the Jahrom University of Medical Sciences's local ethics committee (approval number (Ref.No.993925 From National center for strategic Research in medical education) and written informed consent was obtained from all the participants.

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Interdisciplinary Journal of Virtual Learning in Medical Sciences

Special Report

Affective Domain Devaelopment in Virtual Education: Visual Thinking Strategies and Art Pedagogy

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ABSTRACT

Development of the affective domain is linked to increasing self-awareness of internal dialogue, such as biases and assumptions, which can affect the ability of nurses to engage in person-centered care and meet the identified patient outcomes. Through visual thinking strategies (VTS) paired with art-based pedagogy to examine grief, loss, and bereavement concepts in a hospice and palliative care nursing virtual education course, affective domain development was advanced. Foundational to this virtual educational intervention was using the VTS framework of questions and pairing them with art-based pedagogy promoting open-ended interpretation and response to the art presented. This assisted the students in identifying relevant information, making judgments, and connecting them to previous knowledge. Using VTS with an art-based pedagogical framework enhanced person-centered competencies of empathy, understanding diverse perspectives, and advanced critical thinking and observational skills. Applying this teaching strategy to various healthcare disciplines, changing the concepts, and utilizing varying art-based pedagogical formats can easily be adapted into virtual courses, preparing healthcare practitioners to meet identified curricular needs and learning outcomes and advancing patient-centered competencies.

Keywords: Education, Nursing, Distance, Teaching, Thinking

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Problem

Nurses must possess keen observational and assessment skills concerning patient conditions and circumstances (1). Observational and evaluation skills are central to promoting the identified patient outcomes by noticing changes in conditions or situations and modifying care appropriately (2, 3). This requires the nurses to possess strong affective domain skills to interpret the situation and critically analyze and synthesize data gathered to inform and direct the care provided. The affective domain consists of five levels beginning with awareness and attention or "receiving" of cues, data, and communication. The second and third levels focus on the nurse's behaviors and attitudes connected to what is received. The fourth and fifth levels involve "organization" and integration, or the ability to incorporate new awareness, behaviors and attitudes into nursing practice (4-6).

Affective domain skills are often influenced by the nurse's own life experiences, perspectives, or inferences, potentially leading to the development of implicit biases, which

cause improper deductive reasoning or actions (2). The nurse may not be consciously aware of their implicit biases and assumptions and may use them to predict expected behaviors or responses to care or situations. Nurses must be aware of their biases and assumptions and open-minded to the evidence presented (7). In addition, the nurse must embrace the possibility that their observation and assessment of the situation or circumstance could be affected by implicit biases and assumptions, jeopardizing their nursing judgment, treatment decisions, and the care delivered (8). The pairing of observational and assessment skills with person-centered care is based on a holistic view of the patient and the ability to understand and receive various perspectives and interpretations of communication and meaning (9). Incorporating art-based pedagogies into the nursing curriculum can assist in developing the student's affective domain, providing for nurses who can effectively engage in holistic and person-centered care (10).

Enhancing self-awareness of internal processes and observational and assessment skills leads to the requisite development of the affective domain. The affective domain is globally recognized for its importance in helping the nurse manage the emotional contexts of interacting with people with diverse views and experiences (11). Affective domain skills include communicating empathy and compassion, considering other perspectives and lived experiences, and understanding the context of an individual's decisions, behaviors, or lifestyle. Affective domain skills also contribute to critical analysis, synthesis, and the ability to view concepts or ideas from various standpoints and enhance critical thought. Visual thinking strategies (VTS) paired with art-based pedagogy in nursing curricula can enhance person-centered competencies, such as communication, and improve observations and assessment skills, tolerance for uncertainty, analysis, and teamwork competencies across various settings (2, 12, 13). Integrating art-based pedagogies into virtual coursework can promote affective domain learning outcomes such as valuing a person's inherent worth, being willing and able to receive a variety of perspectives, and understanding the relationship between values and attitudes and how these can affect behaviors (4).

Solution

Abigail Housen and Philip Yenawine designed VTS to create opportunities for inclusive discussion using small group methods based on interpretation, perception, and interaction, facilitating a discovery process on selected art images. This was based on Housen's theory of Aesthetic Development and how people perceived visual art and is most often used in live courses with in-person participation (12). The foundation of VTS is an "open-ended" facilitated discussion around selected images based on three fundamental questions (13): 1. What is going on in this picture? 2. What do you see that makes you say that? 3. What more can we find? These questions assist the students in identifying relevant information, making critical judgments, and then connecting these to previous knowledge and schemas (2, 3). In question one, "What is going on in this picture?", the goal is to focus on the image and enhance the discovery process, promoting multiple interpretations, connections, and ways of meaning. Question two, "What do you see that makes you say that?", promotes reasoning and connection with the context of the image. The third question, "What more can we find?", expands the analysis process and can lead to observational or noticing skill development (12).

VTS has art-based pedagogy as its foundation. Art-based pedagogy can be delivered with various artistic approaches, such as drawing, painting, improvisation, music, dance, poetry, or any other type of creative expression (10). A common concept in art-based pedagogy is "openness," allowing for an open-ended interpretation and response to art (14). Incorporating art into an assignment can encourage the student

to self-reflect upon their own beliefs and vulnerabilities, as well as those of others, and embrace diverse perspectives concerning the content, engaging the student in learning by linking emotions to the cognitive process, reasoning, and problem-solving (15). VTS based on art-based pedagogy can allow students to participate in transformative learning, adjust and adapt their perceptions and thinking processes, and enhance affective domain development.

Assignment Pairing VTS and Art-Based Pedagogy

Nursing practice often requires providing care to others during highly emotional times. The nurse must use well-developed observational and affective domain skills and understand "other ways of knowing," being self-aware of their beliefs and attitudes concerning emotionally charged issues and situations (16). To address the development of the affective domain, we created and implemented an assignment based on VTS and art-based pedagogy in a virtual asynchronous hospice and palliative care nursing course in an online associate degree registered nurse to baccalaureate degree completion program. Hospice and palliative nurses must address emotionally charged situations such as end-of-life processes, active dying, and emotions of grief and loss. Student learning outcomes for this assignment included enhancing the student's ability to examine the concepts and emotions of grief, loss and bereavement, reflect upon the student's feelings and beliefs, and consider diverse perspectives concerning these concepts. A secondary outcome was integrating knowledge from the humanities, art in this case, into the science of nursing.

An Internet search for art was performed to find artwork displaying variations of the concepts of grief, loss, and bereavement as this was the focus of the assignment. Ultimately, about 20 pieces of artwork were selected and reviewed to determine the copyright status and if they could be posted to the virtual education learning management system. There were other items to consider, such as the diversity of art, different cultural genres, and quality of the art for viewing in the virtual format. Ultimately seven pieces of artwork were selected to be included in the assignment as they were available open source, represented various genres and had good visual quality. Additionally, the artwork chosen provided different interpretations or potentially had multiple narratives. See Table 1 for the list of artworks used in this assignment.

Three basic VTS questions were used to create asynchronous discussion board prompts, focusing on analyzing and critically reflecting on the image and applying the student's prior knowledge and experiences, thus supporting constructivist learning theory (12). The VTS questions were adjusted to meet the need to focus on observational and assessment skill development. In addition to "What is going on in this picture?" words such as observe, notice, and see were added to hone into aspects of the nursing process, which required reflecting upon multiple aspects of a situation and doing an environmental scan. In addition, to focus on the discussion, we pointed out the concepts related to the goals of the assignment in the discussion prompt.

The second VTS question, "What do you see that makes you say that?" was asked while words such as explain and think were added,

Table 1: Assignment Artwork

Artwork Title	Artist
Untitled Pinax (Plaque) - 6th Century B.C	Gela Painter (Real Name Unknown)
Monastery Cemetery in the Snow - 1819	Caspar David Friedrich
Oak Fractured by Lightning - 1842	Maxim Vorobiev
The Isle of the Dead – 1883	Arnold Böcklin
Inconsolable Grief – 1884	Ivan Kramskoi
Old Man in Sorrow (On the Threshold of Eternity) – 1890	Vincent van Gogh
A Funeral – 1891	Anna Ancher

as these are critical aspects of nursing. The nurse must be able to think critically through a situation and provide a rationale for why he/she believes or perceives something concerning a patient's condition or situation. An additional question was added to address the need for the students to be aware of their biases, assumptions, and beliefs that might affect how they interpreted the image and explore alternate ideas, perspectives, and narratives represented in the picture. The third VTS question was expanded to include essential words for nursing practice, such as notice, encouraging the student to review the image for critical items missed on the first pass. See Table 2 for the discussion prompts used compared to the usual VTS questions.

This assignment was given in an asynchronous discussion board format, so that each student posted his/her initial response and reviewed other peers' postings to further understand diverse perspectives and alternate interpretations and applications of the artwork, opening communication between peers about essential concepts. This impacted the student's ability to engage in dialogue with others about new or different perspectives, self-reflection, and critical analysis, and enhanced the "openness" concept as there is no right or wrong way to interpret or approach the artwork (17).

Results

VTS paired with art-based pedagogy is effective in the virtual learning environment and supports transformative learning, interaction in the community of learners, critical reflection and thinking skills, and conceptual schema development (10). The VTS questions can be adjusted to represent multiple disciplines and concepts, focusing on specific learning outcomes. Questions can be scaffolded, beginning with the basic VTS questions and advancing to a more in-depth critical analysis of the art and how the concepts found and reviewed can be applied to the student's future nursing practice. Additionally, the images or type of art can be adjusted to focus student learning on other learning domains and goals. VTS allows this flexibility as images or other art forms can be selected to challenge the student and align with curricular outcomes and goals.

Assignments utilizing VTS and art-based pedagogy are based on the constructivist view, involving exploration, identification of relevant information, and organization of information, supporting the development of the affective domain (11). This assignment promoted an in-depth discussion of the concepts of grief, loss, and bereavement and how each image may support a variety of narratives and emotions. The results indicated that as students took a second look at the picture, they noticed items they missed on the first pass, and more profound meaning-making occurred. An informal analysis of discussion board postings was conducted, examining the posting content for meta-cognitive activity, self-reflection, and the student's ability to receive and perceive alternate interpretations of meaning in art. The analysis indicated that students were empowered to focus on developing observational skills, sharpening aspects of the image, seeing alternate contexts and interpretations, and visualizing

Table 2: Discussion Prompts Compared to Through visual thinking strategies Questions

Discussion Prompt	VTS Question
Prompt 1: "Describe what you see, observe, or notice in the artwork concerning the concepts of grief, loss, or bereavement."	"What is going on in this picture?"
Prompt 2: "Explain why you think that is what the artwork is representing."	"What do you see that makes you say that?"
Prompt 3: "What new ideas or perspectives did you find when viewing the artwork concerning the concepts of grief, loss, or bereavement that you can apply to your nursing practice?"	None
Prompt 4: Now, go back and look again at the artwork. What else can you find that you did not notice on first view?	"What more can we find?"

how the course concepts could be applied to their future nursing practice in a relevant and tangible manner. Furthermore, this assignment connected nursing science to the humanities. It allowed the student to discuss visual imagery and connect it to their own lived experiences and others through discussion, enhancing inclusive and diverse thinking skills.

Limitations and Suggestions

As one of the limitations of this assignment, it was offered at one university in multiple sections of one virtual asynchronous course, with a specific focus on grief, loss, and bereavement concepts. Further research is needed to examine how VTS and art-based pedagogies can affect the development of affective domain skills. Additionally, the assignment could be examined for application in a synchronous versus asynchronous virtual environment with differing art forms (photography, music, etc.) to ascertain if one type of art-based VTS strategy is more relevant to affective domain and skill development.

When students are engaged in VTS, supported by art-based pedagogy, they can reflect upon their life experiences, reinforcing the growth of the affective domain skills, including empathy and inclusivity. Reflecting on their knowledge and experiences the students are encouraged to reflect critically on those experiences and to become self-aware of personal assumptions and biases. This leads to a transformative learning experience, encourages the students to be more inclusive in attitudes and behaviors, and develops transferable skills, competencies and attitudes for relationship-based and person-centered care, positively impacting nursing care outcomes (18). Nurses must possess solid affective domain knowledge and skills for their nursing practice. VTS paired with art-based pedagogies allows this knowledge and skill development in virtual learning environments.

Conclusion

The innovative teaching method presented in this article was created using VTS and art-based pedagogy as a foundation for affective domain development in an online nursing education program's hospice and palliative care nursing course. Nurses must possess the ability to embrace and recognize diverse views and experiences concerning highly emotional situations such as grief, loss, and bereavement. This assignment focused on the unique affective domain dimension of critical synthesis and analysis skills essential to nursing practice and person-centered care. The use of VTS and art-based pedagogy in the development of this assignment provided an avenue for students to become aware of biases or assumptions that might affect the nursing care delivered. Furthermore, through the integration of VTS and art-based pedagogy into nursing education courses, students can heighten their observational skills and inclusive thinking processes that positively impact nursing practice.

Authors' Contribution

JJ, conceptualization, literature search, and manuscript drafting.

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Ethical Consideration

The preparation of this article did not involve any research conducted on human subjects or animals. Hence approval from the ethics committee is not required.

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Commentary

Importance of Virtual Platforms in Improving the Reproducibility of Data in Cancer Research

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ABSTRACT

Virtual platforms have revolutionized distance education, making it accessible worldwide and empowering scientists, academicians, and researchers to access knowledge effortlessly. These platforms provide flexibility, allowing the users to tailor their learning experience to their needs and integrating knowledge into their work. Reproducibility is crucial in cancer research, and researchers integrate data analysis into virtual or electronic learning (e-Learning) platforms to facilitate replication and verification, promoting transparency and reliability. This integration enhances accessibility and enables collaboration among scientists and stakeholders in the fight against cancer. Virtual learning offers written and audio-visual communication benefits facilitated by electronic and web-enabling advancements. In the dynamic virtual realm, researchers transcend limitations, exchange knowledge, and push the boundaries of cancer research. Virtual platforms provide time efficiency and financial freedom, while advanced tools support data analysis and facilitate new insights. These tools unlock hidden patterns and accelerate the pace of discovery. The digital ecosystem generates new ideas, improves research methodology, and enhances research quality. Limitless collaboration and advanced tools propel cancer research, unravelling complex data with precision and innovation. The potential of cyberspace to revolutionize scientific research in the future, therefore, is promising.

Keywords: Virtual platforms, Cyberspace, Research data, Reproducibility, Cancer research

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Introduction

"You can't teach people everything they need to know. The best you can do is position them where they can find what they need to know when they need to know it."

Seymour Papert

Cancer is a complex and widespread disease characterized by the uncontrolled growth and division of abnormal cells. It can affect various body organs and tissues, leading to tumours forming or infiltrating cancer cells into surrounding tissues. Each year, approximately 10 million lives are lost to this disease, as reported by the International Agency for Research on Cancer (IARC) (1). Being a leading cause of death worldwide, the burden of cancer on individuals, families, and societies is significant. The weight of this burden highlights the urgent need to advance

our knowledge through scientific inquiry to develop effective strategies for prevention, early detection, and treatment.

Researchers continually expand their knowledge through scientific inquiry and develop innovative methods, procedures, and techniques. This ongoing quest for understanding fuels progress and enables others to build upon existing findings. By fostering efficient scientific processes, this collaborative approach deepens our comprehension of humanity and the universe and ultimately aids in substantial advancements across various domains. In the cancer context, scientific research is a powerful tool in the ongoing fight against this devastating disease.

In recent decades, significant progress has been made in cancer research, encompassing pathogenesis, diagnostics, and treatments, all aiming at improving patient outcomes. Technological advancements have opened new avenues of investigation, such as genomics, proteomics, targeted therapy, and artificial intelligence. However, the abundance of data generated poses challenges in verification and validation. Nonetheless, scientists are actively addressing this challenge to harness the potential of these breakthroughs and advance cancer research.

Unlocking Opportunities in the Digital Realm

Scientific journals are essential platforms for sharing discoveries, facilitating education, and advancing knowledge. With the evolution of the Internet, accessing these journals has become more convenient, eliminating the previous cumbersome processes. The availability of cancer data holds immense value, enabling researchers to comprehend the impact of cancer on populations, identify risk factors, and develop effective prevention strategies. This knowledge is critical for recognizing patterns and trends, ultimately contributing to improved cancer care. The Internet has revolutionized research and learning, becoming an indispensable tool for professionals and researchers. It provides a wealth of virtual sources and platforms that allow for in-depth analysis and understanding of various subjects at one's own pace. Researchers heavily rely on the Internet for their investigations, making it an indispensable component of their work. With its vast resources and accessibility, the Internet continues to enhance and accelerate scientific advancements in the fight against cancer and numerous other fields of study (2).

Scientific journals, while a vast source of knowledge, also pose challenges. The data presented in published studies may not always be easily reproducible or transparent, leading to concerns about the reliability of certain findings. It calls for a greater emphasis on reproducibility, transparency, and scientific evidence to ensure research integrity. By exploring different definitions of effectiveness and embracing the concept of virtual reality, learning professionals can align their expectations and focus their efforts on what truly matters. This reflection and inspiration can guide the utilization of virtual platforms, empowering professionals to enhance their learning experiences and achieve meaningful outcomes.

Virtual platforms and cyberspace offer numerous advantages in the realm of cancer-related activities. They serve as efficient data collection, analysis, and storage tools, contributing to a deeper understanding of cancer incidence, prevalence, and risk factors. Virtual platforms also facilitate the dissemination of valuable information on cancer prevention, detection, and treatment through online resources and support communities, reaching a broad audience. They provide a vital space for individuals impacted by cancer to connect, share experiences, and access support resources.

A significant advantage of virtual platforms is their support for telemedicine (3). Patients can remotely consult with healthcare professionals, receive medical advice, and undergo specific diagnostic procedures without physical visits. This accessibility and convenience improve patient care and overcome geographical or mobility barriers.

Telemedicine in oncology broadens access to quality healthcare services, revolutionizing patient care. Virtual tumour boards are another valuable tool, fostering collaboration among multidisciplinary teams. By leveraging the expertise of various specialists, these platforms facilitate collective treatment decision-making, leading to improved patient outcomes and enhanced quality of care. The advent of virtual media has transformed cancer care, offering remote consultations, reducing travel burdens, and promoting multidisciplinary collaboration for better treatment outcomes.

Reproducibility in research relies on replicating data, methods, and codes to validate previous findings or generate new datasets. Transparency is a valuable attribute, but its definition could be more precise, striking a balance between providing individuals with the necessary information to evaluate scientific claims and study design (4-6). Furthermore, virtual platforms facilitate the opportunity to engage in constructive and open conversations, promoting mutual understanding and sharing materials and data, leading to increased research productivity. A recent study by Errington et al. focused on examining the reproducibility of numerous cancer studies. Surprisingly, they could only replicate 27% of the 195 experiments conducted in these studies. The authors attributed this low replication rate to inadequate methodological details, insufficient use of appropriate statistics, and the necessity for protocol modifications (7).

Navigating the Obstacles

Reproducibility

Ensuring the reproducibility of scientific discoveries has become a significant challenge in recent times. Many studies may suffer from issues such as false positives or inadequate sample sizes and statistical power, making it difficult to determine the reliability of their findings. The lack of uniform scientific practices across disciplines further hampers replicability. To address these challenges, online assessments, practice assignments, and simulated procedures can provide uninterrupted learning experiences and foster a more consistent approach to research and knowledge acquisition.

Data Availability

Online platforms empower researchers with essential data management, documentation, and analysis training, ensuring accurate and reproducible results. They provide access to the latest advancements in data curation and analysis techniques, informing researchers about cutting-edge methods. Comprehensive data availability aids early cancer detection, risk identification, and targeted screening. Analysing large datasets yields insights into molecular markers, genetic mutations, and tumour characteristics, advancing cancer understanding. These findings support personalized and precision medicine, improving treatments and patient outcomes. Online platforms enable real-time research monitoring and remote meeting participation and foster collaboration, enhancing research efficiency within the scientific community (8).

Publication Terms and Conditions

A scientific workflow encompasses various stages, including idea generation, literature review, study design, data collection, analysis, and reporting. With the advent of online resources, researchers have access to vast amounts of information. They can utilize statistical and cyber domain modules like bioinformatics to effectively organize and analyse biological data. However, the reproducibility of research findings faces challenges related to workflow decisions and result documentation. Journals often limit the amount of information that can be included, potentially leaving out crucial details. Additionally, there is a publication bias towards positive findings, leading to the potential neglect of negative studies. To address these limitations, it becomes essential to have comprehensive information about the study question, methods, and analysis throughout the research process, allowing for

better transparency and reproducibility (9).

Rigorousness

Virtual learning enables direct communication with authors, fostering an understanding of challenges in original studies and improving protocols for better repeatability. Collaboration is vital, but reproducibility suffers from unsound procedures and results in misinterpretation. To improve scientific reproducibility, researchers should focus on rigor. Rigor encompasses adherence to rigorous experimental design, robust data collection and analysis, and meticulous documentation of methods and procedures. By upholding these principles, researchers can minimize bias, increase the transparency of their work, and facilitate the replication of their findings by other scientists. Rigorous research practices not only contribute to the advancement of scientific knowledge but also promote trust and confidence in the scientific community. Therefore, it is essential for researchers to continually emphasize and prioritize rigor as a fundamental aspect of their work, ultimately enhancing the reproducibility and integrity of scientific research.

Preregistration

Online platforms now allow preregistration of study plans, promoting transparency and accountability. Preregistration supports study design, randomization, outcome selection, and peer review before publication. It counters selective reporting and publication biases, enhancing reproducibility. By preregistration, researchers can avoid data-driven interpretations and ensure a more robust and reliable scientific narrative. This approach has proven successful in clinical studies, leading to increased reporting of null results and reducing biases in the literature. Implementing preregistration for all studies before journal publication can serve as a solution to decrease biases and improve the quality and transparency of research findings (10, 11).

Outcome Reporting Bias

Outcome reporting bias continues to be a prevalent issue, with a significant percentage of trials experiencing changes, introductions, or omissions of primary outcomes and a substantial number of pre-specified effects going unreported (12, 13). The solution to this problem lies in the universal registration of all trials, complete reporting of results, and formulation of clear rules and standards for experimental procedures, data collection, and analysis methodologies. By implementing such measures, we can ensure transparency, integrity, and reliability in research, ultimately enhancing the trustworthiness and impact of scientific findings.

Scientific Transparency

Challenges such as scrutiny, methodological issues, and publishing pressures jeopardize the credibility of our scientific landscape. However, embracing emerging technologies can foster progress and enhance our understanding. As advocates for research funding, we must support organizations that promote transparent and open science. We cannot afford to waste time on research concealed by financial and non-transparent barriers. Scientific transparency fosters inclusivity and comprehension. Nevertheless, political and business interests must address obstacles to scientific progress, such as high costs and limited openness.

The Digital Frontier: Exploring the Impact and Influence of Cyberspace

Cyberspace has revolutionized the scientific landscape, offering digital resources that eliminate the need for physical copies of publications. Open-access publishing has emerged as a powerful catalyst for scientific openness, enabling researchers to readily share their findings while preserving the confidentiality of sensitive or proprietary information. Embracing virtual platforms and open science practices empowers researchers to bolster the efficiency and credibility of their scientific pursuits in the relentless battle against cancer. Moreover, these platforms

empower cancer advocacy organizations and patient groups to raise awareness, advocate for policy changes, and effectively allocate resources. Through online campaigns and social media, they can reach a broader audience, engage policymakers, and mobilize support for improved cancer services. Integrating virtual platforms, open-access publishing, and collaborative efforts paves the way for a more transparent and impactful scientific community, ultimately benefiting patients and advancing our understanding of cancer (14).

In the field of education, virtual platforms enhance the learning process and have the potential to transform teaching and learning methods. They can increase lifelong learning opportunities, improve instruction, and streamline administrative tasks. Online learning supports individualized learning, helps students reach their full potential, and fosters a flexible and adaptable education workforce (15). To ensure reproducibility and quality in research, there is a need for rigorous peer review processes, easy access to protocols, and recognition of excellence and accuracy in scientific work. Creating a culture that values reproducibility and rewards integrity will contribute to a more reliable scientific community.

Overall, the future of virtual platforms holds tremendous potential. Integrating emerging technologies and the constant evolution of virtual platforms will shape a future where remote communication, accessibility, sharing, collaboration, and virtual teams become the norm in cancer or other scientific research.

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Authors' Contribution

AV wrote the initial draft, YK conceived the idea, executed the study, and drafted and revised the manuscript. Both authors have read and approved the manuscript.

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